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TECHNOLOGY REVIEW

February 1957

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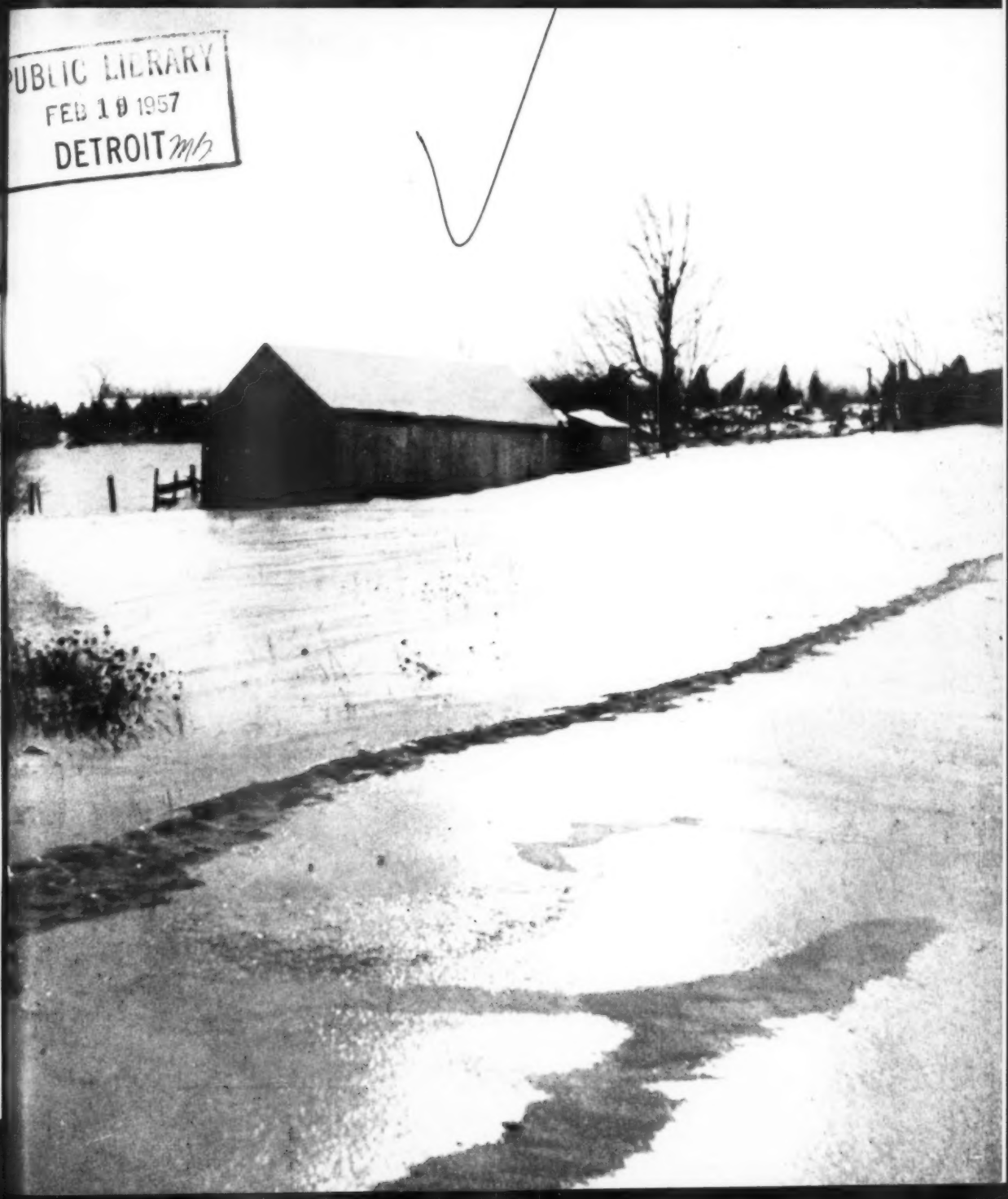

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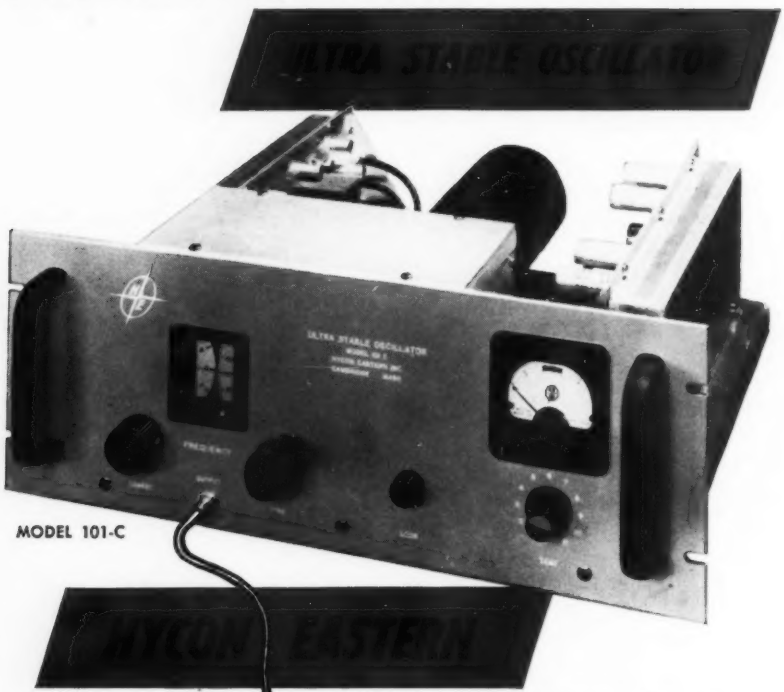

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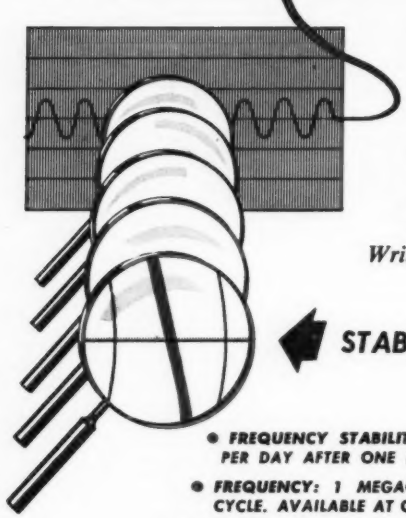

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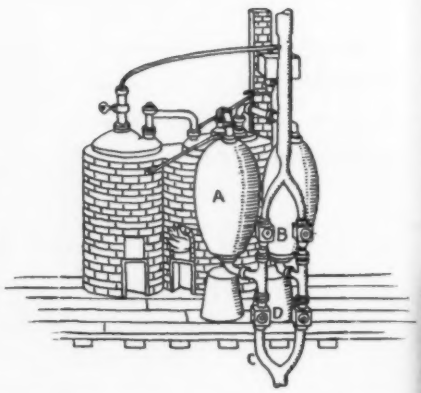

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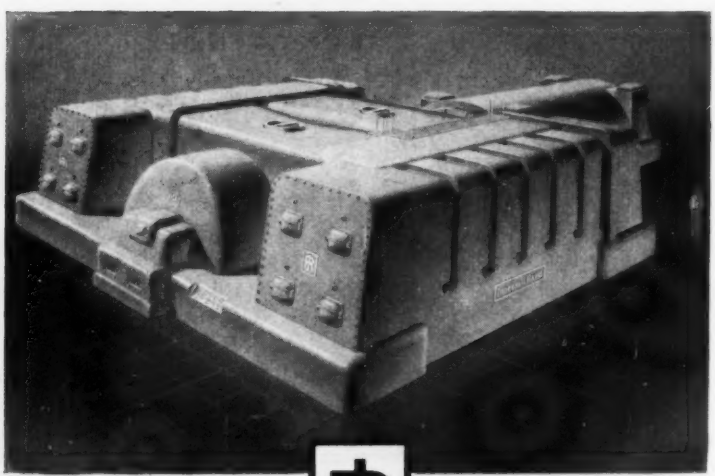

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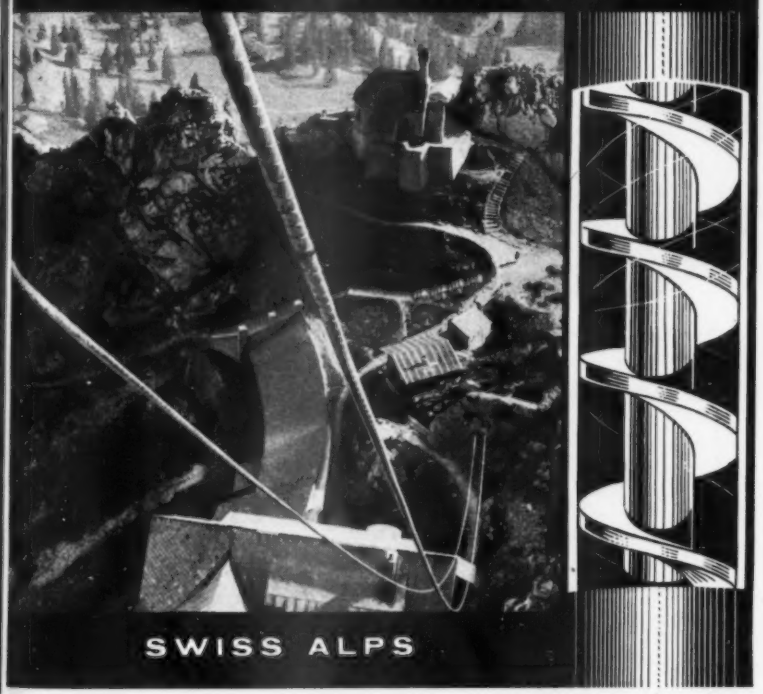

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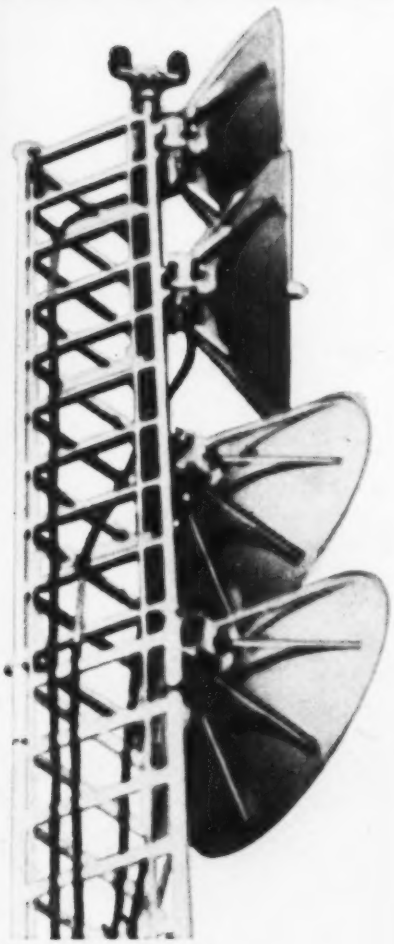

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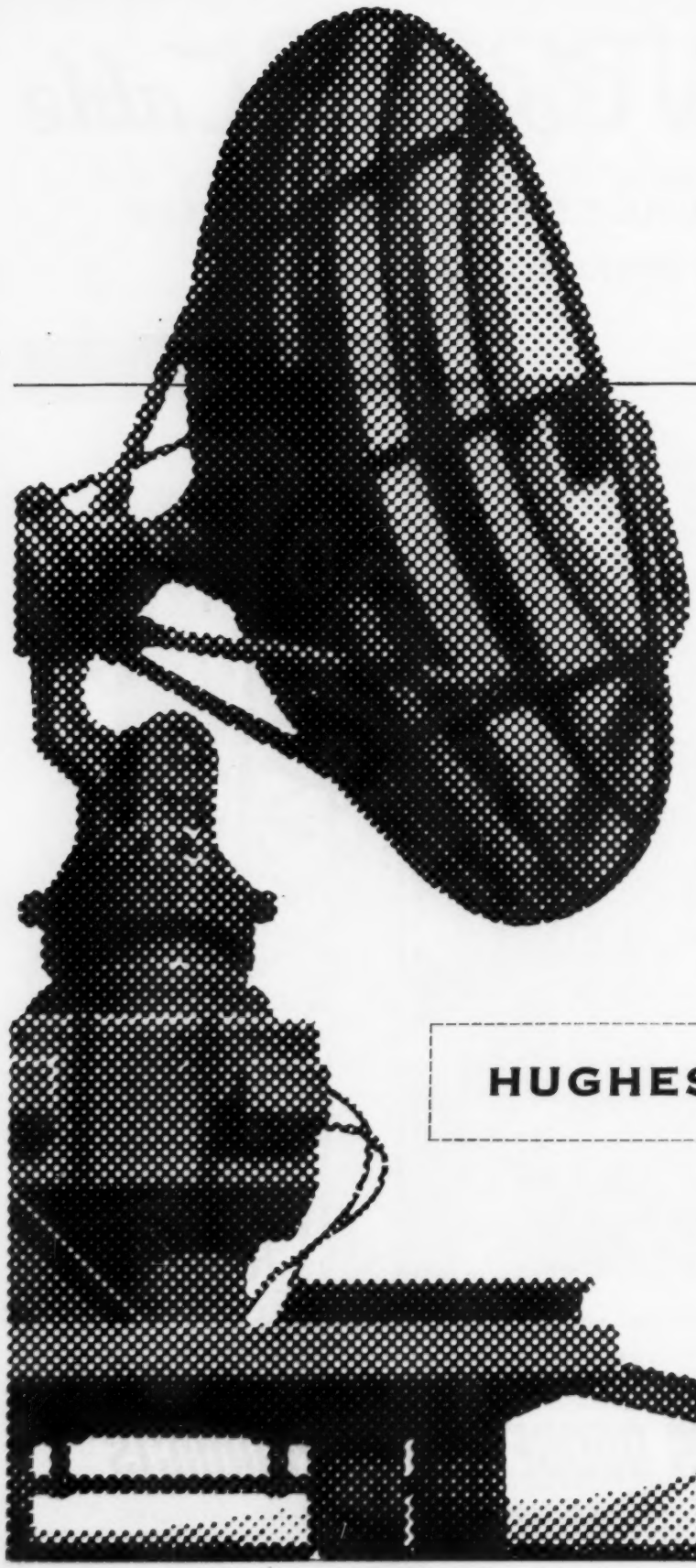

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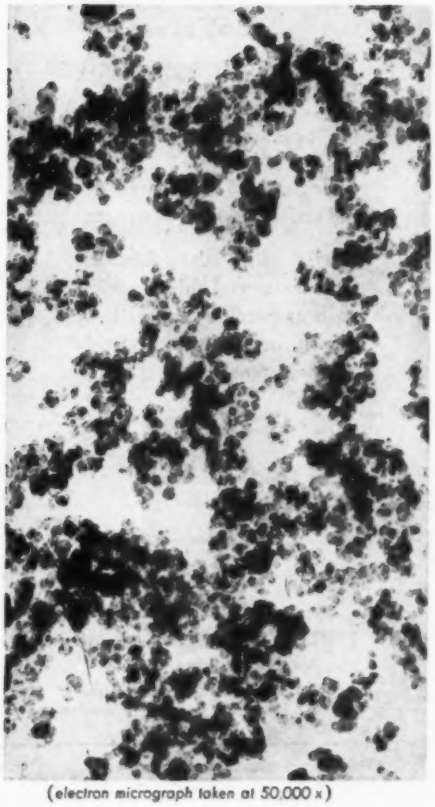

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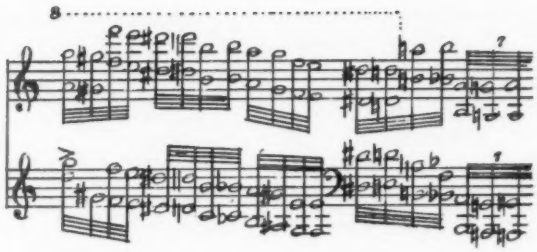
THE TABULAR VIEW

Liberating Creative Energy. — An industrial society, such as that which much of the Western world has created for itself, makes quite different demands upon its educational system than, let us say, an agrarian society. In "Education for Our Industrial Society" (page 197), WILLIAM R. HAWTHORNE, '39, of the Department of Engineering of the University of Cambridge, examines the type of training that appears to be best suited to Anglo-American needs. Holding that physics and mathematics might well play a more significant role in current training, Professor Hawthorne believes that, whatever subjects are taught, proper instruction, inspiration, and social support are required to raise society to higher levels of achievement so that the creative energies of our people can be released. Text of The Review article is based on the Mollie B. Mandeville Lecture he delivered at Brown University on April 25, 1956, while Professor Hawthorne was Jerome Clarke Hunsaker Professor of Aeronautical Engineering at M.I.T. A native of Benton, England, Professor Hawthorne received the B.A. degree from Cambridge University in 1934 and a year later came to M.I.T. as a Commonwealth Fund Fellow, where he studied fuel engineering and received the Sc.D. degree in 1939. He joined Babcock and Wilcox, in England, as development engineer, working on combustion, heat transfer, and steam generation. From 1940 to 1944 he was scientific officer and head of the Gas Turbine Division at the Royal Aircraft Establishment in Farnborough, and later became deputy director of engine research at the Ministry of Supply (Air) in London. He returned to M.I.T. in 1946 as associate professor of mechanical engineering, and from 1947 to 1951 was George Westinghouse Professor of Mechanical Engineering. Except for his Hunsaker Professorship at M.I.T. in 1955–1956, Professor Hawthorne has been at the University of Cambridge since 1951.

Soup's On! — A growing amount of increasingly complex equipment, much of it electrically operated but all of it requiring cleaning, maintenance, and repair, seems to be required in the modern home kitchen. Perhaps it is understandable, therefore, that the modern housewife may have mixed feelings regarding the blessings which the mechanization of the kitchen is supposed to have brought. But mechanization is merely one aspect of the impact technology has had in bringing about a marked change in the home preparation of foodstuffs; certainly the food-processing industry has brought about a drastic revolution in home cooking. In fact — possibly stimulated by the fact that the average family can no longer afford to employ culinary help, even if it could find personnel for hire — the food industry even claims that some of its products include a "built-in maid service." The revolution which technology has wrought in America's kitchens in the past half century is examined (page 201) by HARRY W. VON LOESECKE.

(Concluded on page 184)

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THE TABULAR VIEW

(*Concluded from page 182*)

Mr. von Loesecke has spent his professional life in, or closely affiliated with, the food industry and obviously does not share the view that "Science Has Spoiled My Dinner"—to take a title from an article by Philip Wylie in the April, 1954, issue of the *Atlantic Monthly*. After graduation from Harvard University, Mr. von Loesecke became research chemist for the General Electric Company, the American Protein Corporation, and the United Fruit Company. He has also been senior chemist, industrial specialist, and technical adviser in a variety of projects related to agriculture and the food industry. Mr. von Loesecke is a fellow of the American Public Health Association.

Red Plague.—As in other articles he has written for The Review over the past decade, in this issue (page 204) JAMES A. TOBEY, '15, traces the origin and spread of another of man's maladies. Dr. Tobey shows how modern therapeutics has achieved marked success in the past 10 years in a segment of public health in which laws and education have, unfortunately, made but little headway. Dr. Tobey brings to this article—as to his other writings in The Review and elsewhere—a vast knowledge of public health law, and related matters. After having attended the Roxbury Latin School, he received the S.B. degree from M.I.T. in 1916. He went on to take an LL.B. degree from Washington Law School in 1922, an M.S. from the American University in 1923, and returned to M.I.T. for his Dr.P.H. degree which was conferred in 1927. His professional life has been spent in advancing public health and laws affecting it, in lecturing at such institutions as M.I.T., Yale, Harvard, and Columbia universities. He has been associate editor of the *American Journal of Public Health*, has written about 20 pamphlets and more than 100 articles.

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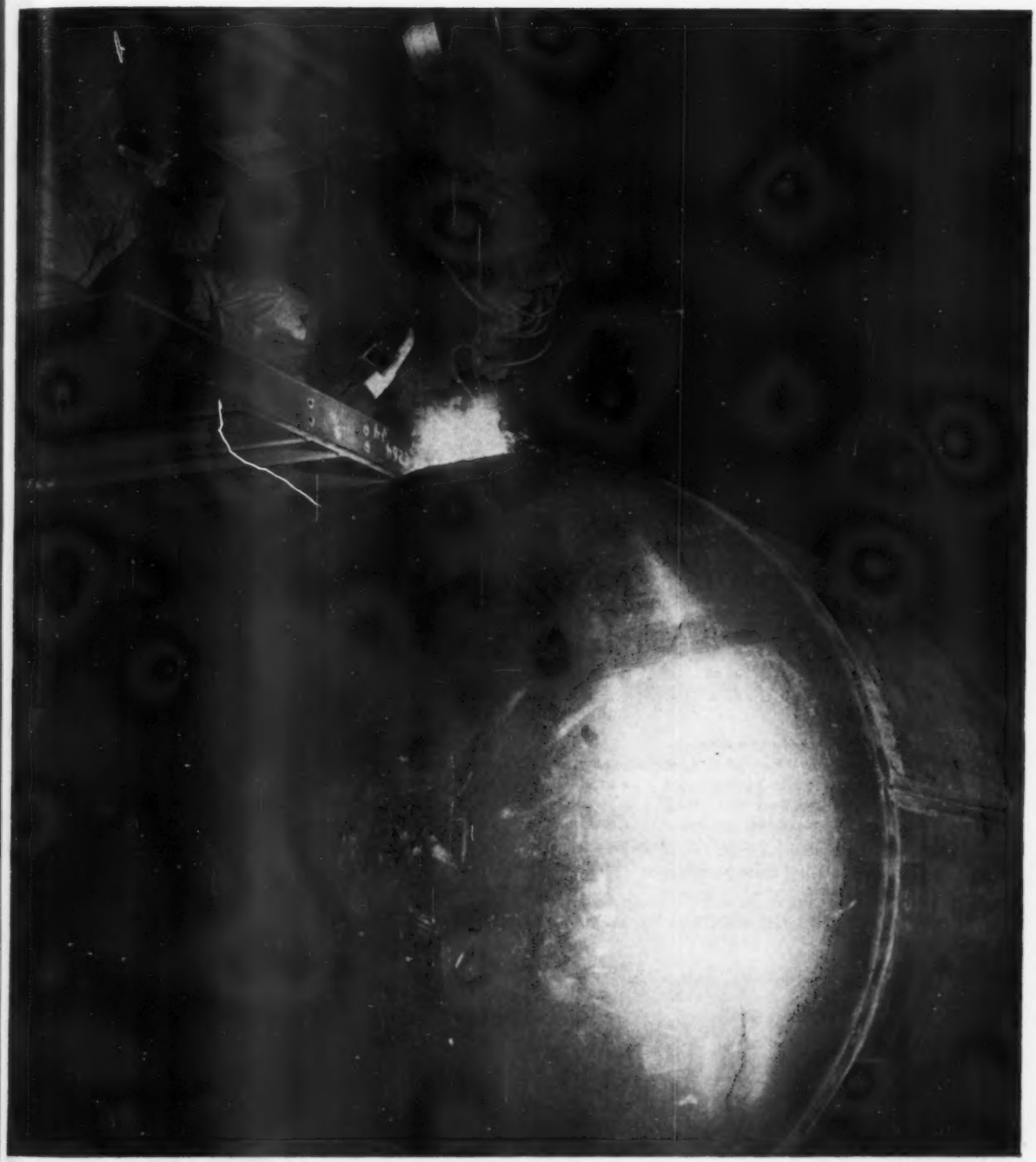

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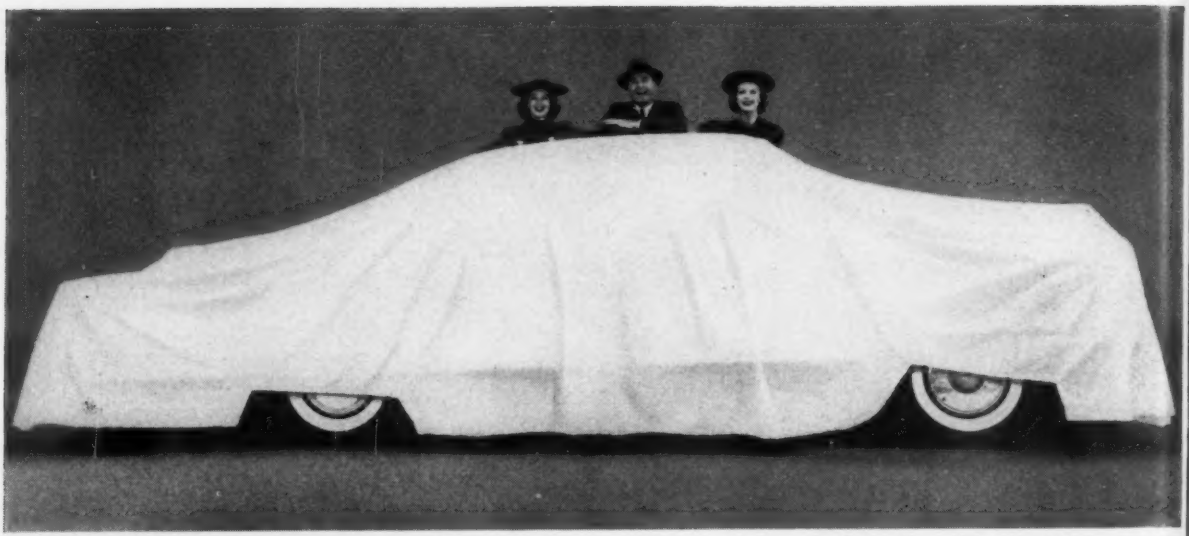

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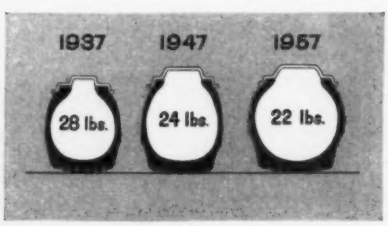

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Technology Review

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Edited at the Massachusetts Institute of Technology

VOL. 59, NO. 4 — FEBRUARY, 1957

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Maurice E. Shank, '40

Bellapais Abbey — Island of Cyprus

The Technology Review

VOL. 59, No. 4 FEBRUARY, 1957

The Trend of Affairs

Discussion Wanted

■ In the pages of The Review throughout the past few years, frequent recognition has been given to the growing importance of higher education in the United States and to the need for rapidly improving the nation's facilities for higher education. The interests of Review readers in this broad subject naturally tend to converge on professional education in engineering, science, architecture, or industrial management. But the basic problem is broader than the need of professional workers; in its broadest sense it involves the training of all manner of persons whose interests, needs, and abilities run the full gamut of human experience.

Man has come a long way from the days of 1794 when French revolutionary masses had no need for scientists and promptly guillotined Lavoisier. Higher education, on a broad scale, is definitely here to stay. We are coming to recognize that true education lays the foundation for a lifetime of continued intellectual self-improvement and expansion. It is becoming clear that college and university programs, desirable as they are, are not the only ways (and possibly not even the most desirable ways in some instances) of maximizing the intellectual potential of the nation's citizenry. Training to the doctorate level and beyond will certainly be necessary and desirable for some, but many more will reach the limits of their intellectual abilities at a lower level of academic discipline. It is in this area that the trade schools, the junior colleges, normal schools, business colleges, adult educational centers, industry schools, technical institutes, and other educational institutions between the high school and the university levels can play their important roles in training successful citizens.

In the past, "success" was frequently measured by the increased income and the social prestige that were presumed to result from college training. As higher education becomes more generally available, and as taxes exert their economic leveling influences, these economic and social drives may well lose much of their former importance. The present aim of providing schooling to the limit of one's intellectual capabilities, without economic barriers to the really qualified, is bound to leave its mark. Already it has raised difficult economic problems.

How to pay for modern education is a serious and vexing matter. The days of the ambitious youth who worked his way through college appear to be numbered. Whether we like it or not, the taxpayer will certainly be called upon to pay much of the bill for the nation's schools at all levels of operation.

The revision of the nation's educational system to meet the needs of the Twentieth (or Twenty-first!) Century is not an easy task. Fortunately, however, it is being attacked by many interested persons. One such group is President Eisenhower's Committee on Education Beyond the High School, headed by Devereux C. Josephs, who is chairman of the Board, New York Life Insurance Company. Serving with Mr. Josephs on this awkwardly named committee are three dozen educators and executives, including Crawford H. Greenewalt, '22.

In mid-November, this committee forwarded to President Eisenhower, its "First Interim Report to the President." This report is bound to interest those who recognize the need for a well-integrated national policy on education. Perhaps it will also stimulate discussion on what the nation's policy should be. Indeed, the committee feels that:

"Effective planning for the future will not get started unless there is discussion first. Nor can we be sure that our recommendations will have public approval unless they have been tested out by many people in many parts of the country. Of one thing the Committee is certain: the American people will decide the various kinds of post-high school education they want. It is our function to pose the problems in such form as may be an aid to these decisions."

In taking stock of the present status of education in the United States the committee says:

"It is agreed that (1) the conservation and development of human talent is the proper concern of every citizen, and of the Nation; (2) every individual, regardless of race, creed, color or national origin, shall have the opportunity to develop his or her best self, to continue appropriate education up to his or her personal point of optimum development; and

(3) the assurance of genuine equality of educational opportunity requires that collectively the institutions and agencies responsible for providing this education be characterized by four attributes:

"Quantity . . . there must be a sufficient number of institutions and qualified faculty persons to provide for all qualified students . . .

"Quality . . . the quality of opportunity offered must be good . . . we must find ways of meeting the pressure of numbers without jeopardizing the quality of present educational opportunities . . . indeed educational methods and practices must be made more efficient as rapidly as the technologies of other fields advance if the quality of education offered is to equal the need . . .

"Variety . . . there must be a variety of educational institutions under a diversity of auspices to offer many choices to individuals of various abilities and talents who differ in interests, aspirations, and beliefs . . .

"Accessibility . . . there must be facilities for education which are accessible to all students if equality of opportunity is truly to be realized."

The committee recognizes that, within the next two decades, demands on all phases of education beyond that of high school will be extraordinary. In seeking to crystallize public thinking toward the development of a national educational policy, the committee submits its preliminary considerations. These may be briefly summarized as follows:

"1. Our ideals and the increasing complexity of our civilization require that each individual develop his or her talents to the fullest.

"2. The needs of the individual and of society plus an unprecedented growth in the population of post-high school age will far outrun the present or planned capacity of existing colleges and universities and other post-high-school institutions.

"3. The needs of the oncoming millions of individuals with varying capacities and interests will call for a broader range of educational opportunities, and less rigid time requirements.

"4. Many more able and qualified teachers will be needed than present efforts can provide.

"5. There must be promptly formulated an explicit, considered policy as to the role of the Federal Government in education beyond the high school.

"6. Even with the best possible utilization of existing resources, additional financial support must be provided if the additional millions in the population are to be enabled to develop their talents to the fullest."

Each of the above points is expanded in the "First Interim Report" published by the United States Government Printing Office. The report is offered as a means of stimulating discussion, and perhaps there will be some who object to some or all of its preliminary conclusions. The committee wisely recognizes that a wide range of educational opportunities will be required. The committee holds that: "In the last analysis, the measure of success of an educational system is the extent to which it kindles in an individual a continuing desire and sense of responsibility for self-development and enlarged understandings."

Federal participation in meeting at least some of the costs of post-high-school education is already being demanded. Questions of educational "rights" are certain to pop up if and when higher education is generally supported by taxes and hence becomes available to all who can – or hope they can – qualify. It is one thing to provide free educational opportunities for those who can truly derive benefits from them; it is quite another thing to award Ph.D. degrees automatically to those who have merely lived through 20 years of school attendance. And, in a democracy such as the United States is, we may be sure that much verbiage will be spilled before we emerge with a clear-cut, well-defined, generally accepted policy on national education.

But that is just the point to emphasize! The committee is interested in your views on education and your reactions to its tentative conclusions. It is seeking answers to a host of tremendously difficult problems affecting 168,000,000 United States citizens – and their descendants.

William C. Potter: 1874-1957

■ William C. Potter, '97, one of the world's foremost bankers and industrialists and an emeritus life member of the M.I.T. Corporation, died in Albany, Ga., on January 2. He was 82 years old.

Former president and board chairman of the Guaranty Trust Company of New York, Mr. Potter started his career as a mining engineer in the West. He extended his activities to Mexico and the Southwest as general manager of the Guggenheim Exploration Company and the American Smelting and Refining Company, and in 1911 became president of the Intercontinental Rubber Company. Soon after he joined the Guaranty Trust as a vice-president, Mr. Potter became a member of Guggenheim Brothers and continued to serve Guaranty Trust as a director and member of the executive committee.

For his World War I service as chief of the Equipment Division of the Army Signal Corps, Mr. Potter won the Distinguished Service Medal. He returned to Guaranty Trust in 1921 as chairman of the board of directors, relinquished that post to be president of the bank for 13 years, and resumed the chairmanship from 1934 to 1941. Mr. Potter was chairman of the bank's executive committee until 1946, when he became a director, and last January was named a director emeritus. He had also held directorships with the Federal Reserve Bank of New York, Anaconda Company, Bethlehem Steel Corporation, Atchison, Topeka and Santa Fe Railroad, and many other firms, and had served as treasurer and trustee of the Juilliard Musical Foundation. He was among the financial and industrial men who conferred with Presidents Herbert Hoover and Franklin D. Roosevelt concerning the restoration of confidence in the country during the Depression and the changes in laws affecting banks and the stock market when the New Deal was in power.

Mr. Potter is survived by two daughters, Mrs. Jean P. Allen of Southampton, Long Island, and Mrs. Charlotte P. Jennings of New York, and a granddaughter.

Twenty-five Years Ago This Month . . .

■ On February 6, 1932, at the Hotel Statler there took place the 57th Annual Alumni Dinner with Bradley Dewey, '09, the Association's 38th President, as toastmaster.

"Impelled by a warm fellowship and by a strong sense of loyalty," in the words of the then Editor of The Review, James R. Killian, Jr., '26, "to what might be better called their *almus pater*, graduates of M.I.T. instituted in 1876 the first Alumni Association Dinner. It was celebrated at Young's, and those of a total Alumni body of 122 who were present elected Robert H. Richards, '68, President of the Association. From then until now that initiatory dinner . . . has been repeated yearly and elaborated with a zeal that has suffered no diminution. It has grown to be an outward manifestation of an inner unity between the Institute and its Alumni, an occasion for demonstrating and cultivating a productive interrelationship."*

"After the dinner," Editor Killian continued, "there were two scientific demonstrations and two speeches, in addition to the presentation of honorary membership in the Association to Mrs. Ellen King and a formal accolade to Professor James R. Lambirth.

"The first scientific item was in charge of Professors R. D. Bennett and B. E. Warren, '24 . . . and it consisted of a demonstration of Geiger counters. . . . Perhaps the most spectacular part of the demonstration was the loud clicks which were heard by the entire audience and which were produced by the mysterious cosmic rays which scientists are now trying so hard to explain. The second scientific experiment was that of the Van de Graaff 1,500,000-volt generator . . . operated and described by Professor Vannevar Bush, '16, and Mr. E. S. Lamar."

Between the two demonstrations Dr. Allan Winter Rowe, '01, spoke on undergraduate activities, and after the second came the address of the evening, by Dr. Compton on the educational objectives of the Institute. Of these he said: "There are two, and I think only two. One is the training of our students to understand and be adaptable in the world in which they live. The other is the application of science to human welfare through the advancement and application of knowledge, and the training of experts. . . . I would say that M.I.T. has been in the past, and can be even more in the future, a cultural and economic asset of far-reaching significance to this community, to this country, and to the world."

* For 20 years the Association continued to dine annually at Young's Hotel, the site of which was adjacent to Thompson's Spa and Pie Alley; then five successive dinners took place at the old Exchange Club, near Post Office Square. During the first eight years of the new century, the Alumni went across Boylston Street from Old Rogers to the Hotel Brunswick, since which time other Boston hotels have been favored as follows: the Somerset, six times; the Copley Plaza, thrice; and the Statler, twenty-one times.

The setting for the dinner of 1909, to greet the Institute's new sixth President, Richard C. Maclaurin, was Horticultural Hall, Boston; for that of 1913 it was the Hotel Plaza in New York. The first of the 10 dinners in Walker Memorial was in 1918; on the occasion of the first and second Alumni Days, in 1935 and 1936, the dinners were held in Symphony Hall.

On June 11, 1956, the 81st Annual Dinner of the Alumni Association was held in Rockwell Cage as the closing event of the 22d Alumni Day program.

On the Horizon

February 16, 1957 – 10th M.I.T. Alumni Regional Conference, Chicago, Ill. **Theme:** "New Horizons for Industry – M.I.T. Mid-America Conference." **Speakers:** President Killian; Deans E. P. Brooks, '17, and Pietro Belluschi; Professors Walter G. Whitman, '17, and John E. Arnold, '40; Allen W. Dulles, Director, U.S. Central Intelligence Agency. (For further information, consult John R. Kirkpatrick, '48, Arthur D. Little, Inc., 9 South Clinton Street, Chicago 6, Ill.)

February 22–25, 1957 – "M.I.T. Week End in Havana," M.I.T. Club of Cuba. (For reservations, consult Antonio Helier Rodríguez, '21, Concordia 61, Havana, Cuba.)

March 7, 1957 – M.I.T. Club of New York – Dinner at Longchamps Restaurant, 42d and Lexington Avenue, 7:00 P.M. **Speaker:** Eger V. Murphree, '23, Special Assistant to Secretary of Defense. Mr. Murphree will speak on "Guided Missiles." (For further information, consult Anton E. Hittl, '36, M.I.T. Club of New York, 33 East 48th Street, New York 17, N.Y.)

March 14–16, 1957 – 9th Annual Fiesta, M.I.T. Club of Mexico, Mexico City, D.F. (For reservations, consult Clarence M. Cornish, '24, Margaritas 139, Villa Obregon, Mexico 20, D.F., Mexico.)

June 10, 1957 – 23d Alumni Day, 1957, M.I.T. Campus in Cambridge.

September 6–7, 1957 – 2d Alumni Officers' Conference, M.I.T. Campus in Cambridge.

December 7, 1957 – 11th M.I.T. Alumni Regional Conference, Pittsburgh, Pa.

Following Dr. Compton's remarks, President Dewey announced the conclusion of the evening's festivities in his long-to-be-remembered and distinctly pronounced words: "The Alumni will now rise and sting the Sein Song."

. . . In tryouts held at Walker Gymnasium on February 10–11, Joseph L. Levis, '26, qualified as a member of the U.S. team for the 1932 Olympics at Los Angeles where he took *second* in the individual foils competition.

. . . Congratulations were being extended also to Major James H. Doolittle, '24, as winner of the Bendix Trophy at the National Air Races for covering the 2,046 miles separating Burbank, Calif., and Cleveland, Ohio, at an average flying speed of 223 miles per hour.†

† The 1956 Bendix Trophy was won by Captain Manuel J. Fernandez, Jr., U.S.A.F. by covering 1,120 miles from George A.F.B., Calif., to Oklahoma City, Okla., at an average of 666.661 miles per hour, thereby setting a new record.

Individuals Noteworthy

■ Year-end news included the 17 promotions, elections, or appointments which follow:

Ralph T. Walker, '11, as Chairman of the Board of Trustees, New School for Social Research . . . *Luis R. Gonzalez, '12,* as a Director of Cia. Financiera de Inversiones, Inc., of San Juan, Puerto Rico . . . *Everett S. Coldwell, '15,* as a Trustee, Roosevelt Hospital, New York;

Edwin E. Aldrin, '17, as Vice-president, Institute of the Aeronautical Sciences . . . *Walter J. Beadle, '17,* as a member of the Advisory Board on International Business, Chemical Corn Exchange Bank, New York . . . *Walter G. Whitman, '17,* as General Chairman, 1957 Nuclear Congress, Philadelphia;

Albert L. Edson, '21, as a member of the Massachusetts Airport Management Board . . . *Robert J. Hull, '23,* as President, Cities Service Oil Company, Ltd., Toronto, Ont. . . . *Edward J. Hanley, '24,* as a Director, Mellon National Bank and Trust Company, Pittsburgh;

James R. Killian, Jr., '26, as a Trustee, Carnegie Foundation for the Advancement of Teaching . . . *Sidney L. Kaye, '30,* as First Vice-president, Parker Hill Medical Center, Boston . . . *Paul F. Genachte, '33,* as Director of the Atomic Energy Division, Chase Manhattan Bank, New York;

Roland D. Glenn, '33, as General Manager – Vinyls, Bakelite Company, Plastics Division of Union Carbide and Carbon Corporation . . . *Maxwell D. Millard, '33,* as General Manager of Sales, American Steel and Wire Division, United States Steel Corporation . . . *John H. Colby, '35,* as Vice-president and General Sales Manager, Johnson Service Company, Milwaukee;

Lincoln Paige, '35, as Vice-president, Empire Trust Company, New York . . . *Semon E. Knudsen, '36,* as General Manager, Pontiac Division, General Motors Corporation.

■ Recent special honors came to Alumni and members of the Institute Faculty as enumerated below:

To *Robert J. King, '03,* an honorary doctor of science, by Piedmont College, Demorest, Ga. . . . *Vannevar Bush, '16,* honorary fellowship of the American College of Surgeons;

To *Howard W. Green, '16,* a citation for his contributions to the development and use of statistics in census enumeration, by the American Statistical Association . . . *Edward P. Warner, '17,* a 1956 F.S.F. Award, by the Flight Safety Foundation, Inc.;

To *Julius A. Stratton, '23,* its 1957 Medal of Honor "for his inspiring leadership and outstanding contributions to the development of radio engineering as a teacher, physicist, engineer, author, and administrator," by the Institute of Radio Engineers;

To *Howard R. Batchelder, '28,* its Award of Merit, by the American Gas Association Operating Section . . . *William H. Radford, '32,* and *Milton C. Shaw,* M.I.T. Professors, respectively, of Electrical Communications and Mechanical Engineering, alumni citations for showing "that sense of enterprise and civic responsibility that gives strength and purpose to our free way of life . . ." by Drexel Institute of Technology on the occasion of its 65th Anniversary Convocation;

To *R. B. Woodward, '36,* an honorary doctorate of science, by Yale University . . . *José M. Bosch Aymerich, '46,* first prize in architecture, by Spain's 1956 Bienale Hispano-Americana . . . *George R. Harrison,* Dean of the Institute's School of Science, the first Pittsburgh Spectroscopy Award, by the Spectroscopy Society of Pittsburgh.

75 Years of *The Tech*

■ In celebration of three quarters of a century of service to Technology, the managing board of *The Tech,* with John A. Friedman, '57, as editor, and Robert G. Bridgham, '57, business manager, has published a 12-page souvenir issue of this newspaper, dated December 20, 1956. The first page of this unusual issue contains a large photograph of the main entrance to Building 10 and part of the Great Court as it appears today. On page 2 we find a facsimile of a letter of congratulation to the editors and staff of *The Tech* from President James R. Killian, Jr., '26, and, by way of comparison, a list of the original staff together with the names of current staff members. In addition, two points of view on college newspapers are expressed; one from an editorial taken from the first issue of *The Tech,* and the other an expression of views of the present staff.

The remaining 10 pages of the souvenir issue are given over to an historical résumé of Technology affairs as recorded in earlier issues of *The Tech,* whose first issue appeared in mid-November, 1881. *The Tech* has been published ever since and today is the oldest extracurricular activity of the student body.

The pages of this special issue of *The Tech* recall the establishment of M.I.T. by William Barton Rogers, and summarize important M.I.T. events prior to 1881 when the student publication was initiated by Harry W. Leonard, '83, Henry F. Ross, '82, Isaac W. Litchfield, '85, and Walter B. Snow, '82. Other eras in Technology's history are treated under the headings: "1881–1888: Life Begins at Eighty-One," "1889–1897: Struggle Brings Satisfaction," "1898–1909: Years of Confident Expansion," "1910–1918: A Change of Address," "1919–1928: New Ideas Create New Spirit," "1929–1939: Expansion Despite Depression," "1940–1949: Measure of Stature," and finally, "1949–1956: Procession to Prominence."

Throughout its seven and one-half decades of service to M.I.T. students, Faculty, and Administration, *The Tech* has faithfully reported "all the news that's fit to print"; it has editorialized on many topics; it has been instrumental in presenting the students' views on Institute matters; it has taken up the cudgels for many Technology reforms. However, it has not explained why this venerable publication is stoutly to be known as *THE Tech.* But, after one has passed the Biblical age of "three score and ten years," perhaps quibbling over the relative emphasis of an article and a noun is a detail of no great importance.

And so – with a mere 59 years of continuous editorial service to its credit – the relatively young and chipper Technology Review salutes its older brother, along with the able staff who produced the 75th anniversary number of *The Tech.*

Magnetic Tape Recording

■ Magnetic tape recording is used extensively in many fields for the recording and reproduction of experimental data. For many applications, the small amounts of amplitude fluctuation and time error (flutter) encountered in conventional data recorders can be tolerated. In applications requiring an unusually high degree of accuracy in recording and reproducing amplitude and phase information, however, severe restrictions are placed on the types of data storage and playback facilities that can be utilized. Some reduction in time errors has been achieved with special data recorders. Tape recording offers so many advantages that additional efforts to reduce time errors are well warranted.

The usual specifications for tape recorders are based on measurement procedures which include frequency components up to about 300 cycles per second. A recent investigation, conducted at the M.I.T. Acoustics Laboratory, shows that flutter effects at higher frequencies may be even greater than those observed by conventional techniques. This investigation was initiated by F. Mansfield Young, '48, and conducted by Roger H. Prager, '55, of the Division of Sponsored Research, with the assistance of Gabriel Farrell, Jr., of the D.S.R. staff and Robert M. Stein, '59, a student in the Department of Electrical Engineering. The work, in the Institute's Acoustics Laboratory, was sponsored by the Bureau of Ships, Department of the Navy.

The Axis Crossing Interval Meter (ACIM), developed in the Acoustics Laboratory, has been used for flutter measurements. This instrument is an FM discriminator which produces an output voltage proportional to the time intervals between the zero values of an alternating signal. Flutter was measured in terms of fluctuations in time intervals upon playback of a periodic recorded signal.

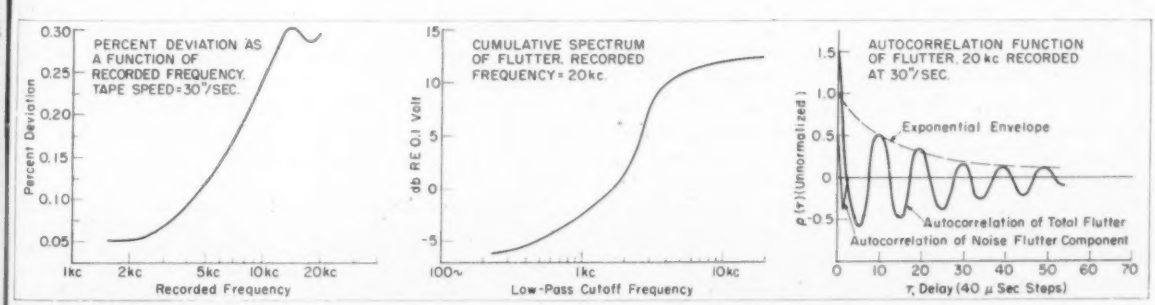
The Ampex Model 3078 dual-channel data recorder, widely used in technical applications, was used in this study. Broadband measurements of total flutter, using the axis crossing interval meter, yielded the data in the left-hand portion of the diagram. Even the broadband measurement is well within the manufacturer's specification up to 4,000 cycles per second.

The center graph shows a typical cumulative spectrum of the flutter, measured with a variable low-pass filter at the output of the ACIM. The results indicate that the flutter consists of two components: (1) a broadband effect causing the spectrum to increase gradually, and (2) a relatively narrow band component causing a sharp rise in the vicinity of 3,000 cycles per second. The former is the result of background noise superimposed on the recorded test signal by recording and playback processes. The narrow band component arises from a mechanical vibration which introduces relative motion between the tape and the heads.

Since flutter is observed as fluctuations in the time scale of the recorded signal, the study of flutter is greatly aided by use of statistical methods. The statistical properties of fluctuating signals have been studied extensively during recent years. Of particular interest for such a signal is the degree to which the fluctuations in two samples of the signals remain consistent as the samples are taken further and further apart in time. Such a property is measured quantitatively by the autocorrelation function of the fluctuations.

The autocorrelation function of the flutter has been used to obtain more detailed information about its components. A typical autocorrelation function, shown in the right-hand part of the diagram, is the sum of an exponentially decreasing cosine component (arising from vibrational flutter) and an additional component (arising from noise flutter). The composite function shown for the total flutter was obtained for a high recording level. At low levels, the autocorrelation function takes on the shape shown for the noise flutter component. The frequency and bandwidth of vibrational flutter can be measured from the frequency and decay of the cosine component in the autocorrelation function. The center frequency of the vibration is found to be roughly 2,700 cycles per second and the bandwidth is about 200 cycles per second.

Vibrational flutter is usually attributed to longitudinal vibration in an unsupported length of tape as it moves past the recording and playback heads. Comparative measurements between the two channels of the recorder demonstrated conclusively that the vibration is longitudinal with respect to direction of the tape motion but the results suggest that the vibration is probably in the heads themselves rather than in the tape. The vibration frequency appeared independent of mechanical properties of the tape. Both record and playback heads have resonances at 2,700 cycles per second, but they also exhibit other resonances that do not show up in flutter measurements. Further study is required to determine the excitation mechanism which selects this particular resonance.



New Approach to Science Teaching

■ During a three-day conference at M.I.T. from December 10 to 13, leading scientists and secondary school educators inaugurated a program which they hope will result in new teaching effectiveness and attracting more young people to the crucial field of science. Representatives of Harvard University, California Institute of Technology, Cornell University, the University of Illinois, and Bell Telephone Laboratories joined with M.I.T. Faculty members and secondary school educators in the project. A new approach for the teaching of high school science is being sought with the support of a grant of $303,000 by the National Science Foundation to the Institute.

In announcing the grant in Washington on December 10, Alan T. Waterman, Director of the National Science Foundation, said: "The Foundation has long realized the need of teachers of secondary school science for better textbooks, better materials, better instruction techniques. Teachers need up-to-date tools to do a competent teaching job. We believe, however, that we must make a broad attack on the problem, rather than approach it on a bits-and-pieces basis."

New laboratory equipment, films, textbooks, and even do-it-yourself laboratory kits for experiments at home are to be considered as possible means of exciting greater enthusiasm for science, especially in high schools where courses in physics and chemistry have begun to languish. But, according to Jerrold R. Zacharias, M.I.T. Professor of Physics, who is chairman of the Physical Science Study Committee organizing the project, the primary consideration is the question of what should be taught. Physics and chemistry are not static subjects and should be taught in a way that will enable students to comprehend exciting new developments, he explained.

James R. Killian, Jr., '26, President of M.I.T., said: "It is now becoming recognized that the current fashion of blaming the shortage of scientists on the shortage of competent teachers in the secondary schools is not a wholly adequate explanation.

"Secondary school teachers and college teachers of science and mathematics must join forces to devise new courses, new texts, new teaching aids which will eliminate outmoded concepts, inadequately defined units, lack of coherence and which, instead, will provide both teachers and students with more penetrating and richer scientific content."

The group includes Vannevar Bush, '16, retired President of Carnegie Institution of Washington, who is now at M.I.T., and two Nobel Prize winners — I. I. Rabi of Columbia University who is a visiting professor at M.I.T. this year, and Edward Purcell, Professor of Physics at Harvard.

Other members of the committee are: Henry Chauncey, President of the Educational Testing Service, Princeton University; Nathaniel H. Frank, '23, Head of the Institute's Department of Physics; Francis L. Friedman, '49, Associate Professor of Physics at M.I.T.; Edwin H. Land, President of Polaroid Corporation and Visiting Institute Professor at M.I.T.; Morris Meister, Principal of Bronx High School of Science; and Walter Michels, Head of the Science Department at Bryn Mawr College.

Visiting Committee Report on Humanities

■ Members of the Visiting Committee on the Department of Humanities* met at Cambridge and Boston for an all-day meeting on Saturday, March 3, 1956. Present for the Committee were Messrs. Barker, Brown, Desmond, MacCallum, Mendenhall, Price, and Chairman Barker. Both Robert M. Kimball, '33, Secretary of the Institute, representing the Institute Administration, and Professor Howard R. Bartlett, Head of the Department, were present throughout.

The morning session and part of the afternoon were devoted to presentations by 12 senior Faculty members of the Department who spoke on their individual responsibilities for the curriculum. All Faculty members of the Department joined the Committee for luncheon at the Faculty Club. An executive session of the Committee (with Professors Bartlett and Edward N. Hartley, Associate Professor of History) in the afternoon gave an opportunity for the Committee to discuss the work of the Department and its problems in substantial detail. The senior Faculty members of the Department, together with John E. Burchard, '23, Dean of the School of Humanities and Social Studies, and Mr. Kimball, dined with the Committee at the Algonquin Club in the evening, which afforded opportunity for further discussion.

The Committee feels that satisfactory progress is being made by the Department, and takes this opportunity of reaffirming its previous judgment as to the desirability of Course XXI in the Institute's curriculum. The Institute Administration and the Department are fully conscious of the fact that this Course needs a descriptive name in addition to its Roman numeral designation. The Committee believes that this is a matter of substantial importance, although it was unable to make a satisfactory suggestion.

After the very thorough review of the work of the Department (made possible by the co-operation of the Faculty members who met with it), the Committee is unhesitatingly unanimous in stating its conviction as to the importance of the Humanities Department in the training of M.I.T. men if they are to take their rightful places in the dynamic world of the present age. With the increasing complexity of this civilization and its problems, specialized engineering and scientific training must be supplemented with such broadening and humanistic studies as are presented by this Department.

The Committee wishes to express its appreciation of the time and effort which Professor Bartlett and his associates gave unstintingly to the Committee in its consideration of the Department's problems.

The report of the Visiting Committee was presented to the M.I.T. Corporation at its meeting on June 8. It was reviewed by the Executive Committee on August 30 and made available for publication in The Review on October 25, 1956.

* Members of this Committee for 1955–1956 were: James M. Barker, '07, chairman, Frederick W. Barker, '12, William H. MacCallum, '24, Richard P. Price, '25, Jacques Barzun (resigned February 16, 1956), Alan W. Brown, John J. Desmond, Jr., Theodore P. Ferris, and Thomas C. Mendenhall.

Calendar of Technology Sports

Date	Time P.M.	Event	M.I.T. Playing	At
Feb. 5	4:00	Vars. Squash	Harvard	M.I.T.
Feb. 6	6:30	JV Basketball	Wesleyan	Wesleyan
Feb. 6	7:30	Vars. Fencing	Bradford Durfee	M.I.T.
Feb. 6	8:15	Vars. Basketball	Wesleyan	Wesleyan
Feb. 9	2:00	Vars. Fencing	C.C.N.Y.	C.C.N.Y.
Feb. 9	2:00	Vars. Hockey	U. of Mass.	U. of Mass.
Feb. 9	2:00	Vars. Swimming	Coast Guard	M.I.T.
Feb. 9	3:00	Vars. Wrestling	Boston U.	M.I.T.
Feb. 9	8:30	Vars. Basketball	W.P.I.	W.P.I.
Feb. 10		Skiing	N.E. College Trophy	Manchester, Vt.
Feb. 12	7:15	Vars. Swimming	U. of Mass.	M.I.T.
Feb. 13	3:00	JV Squash	Middlesex	M.I.T.
Feb. 13	3:00	Frosh Swimming	St. George	St. George
Feb. 13	4:00	Frosh Hockey	Lawrence Acad.	M.I.T.
Feb. 13	4:00	Frosh Wrestling	U. of Mass.	U. of Mass
Feb. 13	4:00	Vars. Wrestling	U. of Mass.	U. of Mass.
Feb. 13	6:15	Frosh Basketball	Boston U.	M.I.T.
Feb. 13	7:30	Vars. Fencing	Harvard	M.I.T.
Feb. 13	8:15	Vars. Basketball	Boston U.	M.I.T.
Feb. 15		Vars. Rifle	Northeastern	Northeastern
Feb. 15	4:00	Vars. Squash	Army	M.I.T.
Feb. 15	6:15	JV Basketball	M.I.T. Frosh	M.I.T.
Feb. 15	8:15	Vars. Basketball	Bowdoin	M.I.T.
Feb. 16	1:00	Frosh and Vars. Indoor Track	Northeastern	Northeastern
Feb. 16	2:00	Vars. Fencing	Stevens	M.I.T.
Feb. 16	2:00	Vars. Hockey	Army	M.I.T.
Feb. 16	2:00	Vars. Squash	Trinity	Trinity
Feb. 16	2:00	Frosh Squash	Trinity	Trinity
Feb. 16	2:00	Frosh Swimming	Andover	Andover
Feb. 16	2:30	Vars. Swimming	Trinity	Trinity
Feb. 16	4:30	Frosh Hockey	Milton Acad.	Milton Acad.
Feb. 16	7:00	Frosh Wrestling	Coast Guard	New London
Feb. 16	8:30	Vars. Wrestling	Coast Guard	New London
Feb. 17		Skiing—	Tufts Trophy	Laconia, N.H.
Feb. 19	7:00	JV Basketball	Harvard	Harvard
Feb. 19	7:30	Vars. Fencing	Boston U.	M.I.T.
Feb. 20	6:15	Frosh Basketball	Northeastern	Northeastern
Feb. 20	7:30	Vars. Swimming	Brown	Brown
Feb. 20	8:15	Vars. Basketball	Northeastern	M.I.T.
Feb. 21	7:00	Frosh Swimming	Brown	M.I.T.
Feb. 22	2:00	Vars. Fencing	Holy Cross	M.I.T.
Feb. 22	4:00	Vars. Hockey	Colby	M.I.T.
Feb. 22	8:45	Vars. Basketball	Pratt	Pratt
Feb. 23	2:00	Vars. Hockey	Alumni	M.I.T.
Feb. 23	2:00	Vars. Squash	Amherst	M.I.T.
Feb. 23	2:00	Frosh Squash	Amherst	M.I.T.
Feb. 23	2:00	Vars. and Frosh Indoor Track	U. of N.H.	M.I.T.
Feb. 23	3:30	Vars. Wrestling	Albany State Teachers	A.S.T.
Feb. 23	8:30	Vars. Basketball	Stevens	Stevens
Feb. 24		Skiing—	Foley Memorial	Franconia, N.H.
Feb. 27	3:30	Vars. Swimming	Springfield	Springfield
Feb. 27	4:00	Frosh Squash	Andover	M.I.T.
Feb. 27	6:30	Frosh Basketball	Tufts	Tufts
Feb. 27	6:30	Frosh Hockey	Tufts	M.I.T.
Feb. 27	7:00	Frosh Swimming	Gardner H.S.	M.I.T.
Feb. 27	7:30	Frosh Wrestling	Boston U.	M.I.T.
Feb. 27	8:00	Vars. Hockey	Tufts	M.I.T.
Feb. 27	8:15	Vars. Basketball	Tufts	Tufts
Mar. 1	6:30	JV Basketball	Coast Guard	New London
Mar. 1	7:30	Vars. Hockey	U. of N.H.	U. of N.H.
Mar. 1	8:15	Basketball	Coast Guard	New London
Mar. 1		Vars. Rifle	Tufts	M.I.T.
Mar. 1-2		Vars. Fencing	New Englands	M.I.T.
Mar. 1		Vars. Squash	Yale	M.I.T.
Mar. 2	2:00	Vars. Swimming	W.P.I.	Worcester
Mar. 2	2:00	Frosh Swimming	Moses Brown	M.I.T.
Mar. 2		Indoor Track	IC4A (N.Y.)	N.Y.
Mar. 2		Vars. Wrestling	Dartmouth	Dartmouth
Mar. 5	7:00	Vars. Hockey	Holy Cross	Holy Cross
Mar. 5	7:00	Frosh Swimming	Brookline H.S.	M.I.T.
Mar. 8-9		Vars. Squash	Nationals	M.I.T.
Mar. 8-9		Vars. Swimming	NEISA	U. of Conn.
Mar. 8-9		Frosh Swimming	NEISA	U. of Conn.
Mar. 9		Vars. Wrestling	NEIWA	Williams
Mar. 9		Frosh Wrestling	NEIWA	Williams
Mar. 15		Vars. Rifle	B.C.	B.C.
Mar. 15-16		Vars. Fencing	Easterns at New York	New York

F. S. Lincoln, '22

Caught at sunrise on a week end are these commercial fishing ships at Brigham's Shipyard, whose president is Theodore W. Brigham, '00. Greenport, Long Island, is the locale.

◄ *Harold E. Edgerton, '27, Professor of Electrical Measurements at the Institute, recently obtained this double flash of Charles Batterman, diving coach at M.I.T.*

Games Played

			Scores		
Date	*Event*	*Winner*		*Loser*	
Dec. 15	Vars. Basketball	Springfi'd	78	M.I.T.	60
Dec. 15	Frosh Basketball	M.I.T.	92	Exeter	69
Dec. 15	Vars. Hockey	Hamilton	5	M.I.T.	1
Dec. 15	Vars. Squash	M.I.T.	9	Adelphi	0
Dec. 15	Vars. Swimming	M.I.T.	60	R.P.I.	26
Dec. 15	Frosh Wrestling	Scituate High Sch.	21	M.I.T.	7
Dec. 19	Frosh Basketball	M.I.T.	67	Belmont Hill	29
Dec. 19	Frosh Hockey	Belmont Hill	10	M.I.T.	0
Dec. 19	Vars. Swimming	Harvard	69	M.I.T.	17
Dec. 19	Vars. Wrestling	Harvard	17	M.I.T.	6
Dec. 19	Frosh Wrestling	Harvard	27	M.I.T.	1
Dec. 20	Vars. Basketball	M.I.T.	69	Lowell	52
Jan. 8	Vars. Basketball	Harvard	76	M.I.T.	60
Jan. 9	Vars. Swimming	M.I.T.	60	Tufts	26
Jan. 9	Frosh Swimming	M.I.T.	56	Tufts	19
Jan. 10	Frosh Basketball	M.I.T.	72	Governor Dummer	43
Jan. 11	Vars. Hockey	Williams	16	M.I.T.	2
Jan. 11	Vars. Rifle	Postal match with University of N.H. No results to date.			
Jan. 12	Vars. Fencing	M.I.T.	17	Trinity	10
Jan. 12	Vars. Hockey	Bowdoin	5	M.I.T.	4
Jan. 12	Frosh Hockey	Middlesex	7	M.I.T.	2
Jan. 12	Vars. Squash	Williams	9	M.I.T.	0
Jan. 12	Frosh Squash	Brooks	5	M.I.T.	0
Jan. 12	Frosh Swimming	Exeter	58	M.I.T.	19
Jan. 15	Frosh Basketball	M.I.T.	78	Harvard	76
Jan. 15	Frosh Squash	Harvard	9	M.I.T.	0

William T. Hall: 1874–1957

■ William T. Hall, '95, Associate Professor of Analytical Chemistry, Emeritus, died in Rochester, Mass., on Friday, January 4, at the age of 82 years.

An active member of the M.I.T. Faculty for 42 years, Professor Hall was born in New Bedford, received his bachelor's degree at M.I.T., and studied at the University of Göttingen, Germany, before joining the Institute staff in 1898 as assistant in analytical chemistry. He was associate professor from 1918 until his retirement in 1940, and from 1942 to 1943 he headed the science department at Thayer Academy in South Braintree, Mass.

The author and translator of many chemical texts and reference works, Professor Hall was assistant editor of *Chemical Abstracts* for 50 years and was a member of the American Chemical Society, American Association for the Advancement of Science, and Sigma Alpha Epsilon.

Professor Hall is survived by his wife, the former Agnes D. Allen; a son, William A., of Philadelphia; four daughters, Catherine S. and Margaret D., both of Rochester, Mrs. Stanley J. Mannette of Boston, and Mrs. George W. Schell of Havertown, Pa.; and a brother, George A. Hall of Portsmouth, N.H.

Visiting Committee Report on Architecture

■ The Visiting Committee on the School of Architecture and Planning* met at M.I.T. on Saturday, March 3, 1956 in the office of Pietro Belluschi, Dean of the School of Architecture and Planning. Present were Charles Abrams, William T. Aldrich, '01, Thomas C. Desmond, '09, Minoru Yamasaki, and William Emerson, chairman. During the morning session, and/or at lunch, President James R. Killian, Jr., '26, Vice-president Julius A. Stratton, '23, Dean Belluschi, and Professors Frederick J. Adams and Lawrence B. Anderson, '30, were also present.

After introductory remarks by Dean Belluschi, the Committee first considered the School's growing resources in fellowships, professorships, and sponsored research projects.

Particular attention was given to the methods of teaching History of Architecture by Albert Bush-Brown, Assistant Professor of Architectural History, and to the report of the *ad hoc* committee appointed by President Killian to consider the future needs of the Department of City and Regional Planning.

Professor Bush-Brown made an excellent analysis of the material and procedure he is using in teaching the history of architecture. It is proposed that eventually there shall be two history courses, one each in the third and fifth years in place of the present single course in the third year. Throughout these

* Members of this Committee for 1955–1956 were: William Emerson, chairman, William T. Aldrich, '01, Thomas C. Desmond, '09, H. Kenneth Franzheim, '13, Thomas D'A. Brophy, '16, Charles Abrams, Richard M. Bennett, Samuel A. Marx, and Minoru Yamasaki.

(*Concluded on page 222*)

Education for Our Industrial Society

Proper instruction, inspiration, and social support can raise society to higher levels of achievement by liberating the creative energies of our people

by WILLIAM R. HAWTHORNE

THERE is no topic which can arouse more passionate discussion than that of education. It is a subject which stirs our hopes, our prejudices, and our fears. It is natural that we should want to transmit to the young the knowledge, the experience, and the wisdom which our civilization has gained, but it is not a task which we do easily or well. We are often over-anxious. The *rites de passage* of the primitive tribes, the Spartan dormitories, the medieval apprenticeships and the English public schools have shown elements of a stern approach to the subject which has often tended to make the education of the human race a long agony of psychological discomfort. "Spare the rod and spoil the child," while it suggests that things learned with pain have remembered significance, illustrates the blind fierceness with which human society has endeavored to protect and perpetuate itself.

Even today education is a focus for many social tensions. We try to protect our youth from heresy by teachers' oaths. We direct searching glances at our educational system when we run short of engineers and scientists. We pillory it for producing uncultured technicians in response to the demands of a materialistic age. We blame it for sloth, incompetence, and juvenile delinquency. The concern with which we view our educational methods and objectives is often so profound that it must surely reflect some deep anxiety about the standards and wisdom of our society.

It would be wrong however to assume that, because we live in difficult times or because there is criticism from one quarter or another, our present-day educational pattern which has been evolved through the efforts of many wise men is a weak or inefficient instrument. It has great elements of strength, not the least of which is its capacity for change and evolution. It is remarkable how the immense variety of new scientific knowledge only recently acquired is now assimilated by many young minds in a space of a few years at school, without driving out the older aspects of our inherited educational tradition. It is remarkable how many people are now capable of understanding ideas which were formerly only appreciated by the very few. In fact the development of our educational system reflects the development of the society in which we live, hence it is not surprising that our educational process today is expensive, complex and difficult.

Let us consider one aspect of the problem of education – the impact of the growth of science and engineering as a major human activity on our educational policy. I do not wish to discuss the questions of how to teach engineering as a specialized subject. This we can leave to schools of engineering such as yours. Instead I want to discuss whether we can continue to regard science and engineering as subjects which need only be taught to specialists or whether science and applying science should be taught even to those who will not eventually become scientists or engineers.

The fact is that all communities today are drawing their real power – the power which supports their commercial and political strength – from their industries, and particularly from those industries in which applied science and technology play dominating roles. We no longer live in a primarily agricultural or mercantile society. Ours is an industrial society.

In this society, as in earlier ones, finance and commerce still play important roles. When the industrial revolution started in England in 1760, new ideas and developments in commerce went hand in hand with the new notion of applying the results of scientific investigation to useful purposes. The development of the steam engine by the mechanic James Watt needed the support of cheap capital as well as the counsel of the scientist, Professor Joseph Black of Glasgow. The growth of economic theory and its application has been a major factor in the creation of our industrial society. But our power today rests basically in our ability to turn natural resources into machines or means of sustenance or defense. It is this power which has enabled us to free slaves, live longer, and increase our population. It has given more leisure, and the opportunities leisure affords, to millions rather than to a very few. It has led us to new philosophical speculation and inquiry and has altered the relations between man and man. The development of this basic power has been, and is, one of the triumphs of the human mind. We describe the intellectual activities involved as science, applied science, and technology.

In the Seventeenth Century the examination of nature, divorced from religious mysticism, attracted the interest of many brilliant thinkers. It was not done in academic isolation, for many of the philosophers of

► The text of this article was originally presented as the Mollie B. Mandeville Lecture at Brown University on April 25, 1956, while Dr. Hawthorne was Hunsaker Professor of Aeronautical Engineering at M.I.T.

M.I.T. Photo

Robert R. Shrock, Professor of Geology, and two of his students at the Institute exemplify the author's contention: "It is remarkable how the immense variety of new scientific knowledge, only recently acquired, is now assimilated by many young minds in the space of a few years at school without driving out the older aspects of our inherited educational tradition."

the day were also men of affairs. In England, Newton became responsible for the Royal Mint and was involved in other government activities. Locke founded the Board of Trade. The beginning of the Eighteenth Century saw the intellectuals and aristocrats of England applying the scientific method to agriculture and manufacture. In 1760 there was an unparalleled surge of innovations in transport, trade and finance and, importantly, in engineering and industry. T. S. Ashton quotes a schoolboy's apt remark: "About 1760 a wave of gadgets swept over England." Whatever the reasons for the suddenness with which the industrial era started, it was not the result of a series of inventions randomly achieved by unschooled mechanics supported by greedy entrepreneurs. Profit and random invention were no new thing. They were the incentive and the evolutionary steps in the growth of manufacture and trade throughout the ages. Much of the invention had been passed along from journeyman to apprentice in the form of what we now call "know-how" – a knowledge of the how to do things rather than the why of doing things. Apprentices learned the know-how as braves in a primitive tribe by watching, trying, being cuffed, and trying again. There are many group activities today in industry and elsewhere in which this useful procedure is still applied.

But, if the industrial developments which marked the beginning of the industrial revolution could be traced only to a remarkable number of random inventions, it would be difficult to explain the developments which have continued with quickening pace ever since. The great innovation of the industrial revolution was to use the methods of natural philosophy for practical purposes. This has not taken the randomness out of invention, but it has supplied, and continues to supply, not only new understanding from which more inventions can spring but also new methods by which they can be nurtured. Our industrial era has therefore been inspired by a new intellectual activity. It is new not because men's minds are sharper, but because the intellectual energy previously devoted to philosophical speculation about man's spirit and man's place in the universe has been directed to understanding nature itself and the artifacts which we ourselves have built. This is an altogether easier problem and we have made good progress with it.

It was fortunate that the natural philosophers who contributed to the knowledge on which much early invention was based, did not distinguish too clearly between the pure and applied branches of their subject. If they had, the growth of much new knowledge would have been retarded. They might have confined themselves to studying natural phenomena, and obtaining important scientific results, which they would then expound to fellow scientists and students. Perhaps a few of their listeners might have had flashes of inspiration in which they invented some useful device based on the new discovery. The true philosophers would doubtless shudderingly withdraw their minds from such indecent thoughts. The mere mortals would be tempted to speculate further. They would become obsessed with the idea and hurry to get backers, patents, and manufacturing resources. Like Boulton and Watt they would have to devise methods of manufacture and train men in new skills. In much of their training they would pass on rules, procedures, and cautionary hints. The trainees would then train others, passing on know-how and taboos. If their machines were useful, a thriving group would establish itself around their design, manufacture and sale. Rival groups might arise to contest their sales. Much know-how might pass between the groups by purchase, capture, or stealth. Our group would defend itself by legal and financial means. Some member of it might devise a new process of manufacture or change the configuration of the machine. When tried, these might be found to give our group an advantage – no one would quite know why. Our erstwhile, but now depraved, philosopher might return to the pure scientist, whose discoveries were the basis of the original machine, with the problem which the competition or the new discovery posed. Here, of course, he would be coldly received. The distinction between the pure and the applied, between science and engineering would be clearly drawn. The pure scientist would not even attempt to understand the problem. His intellectual energy would be devoted to solving the mysteries of nature and not to elucidating the insignificant troubles of some man's profitable but vulgar toy. In any case he would have to talk with a

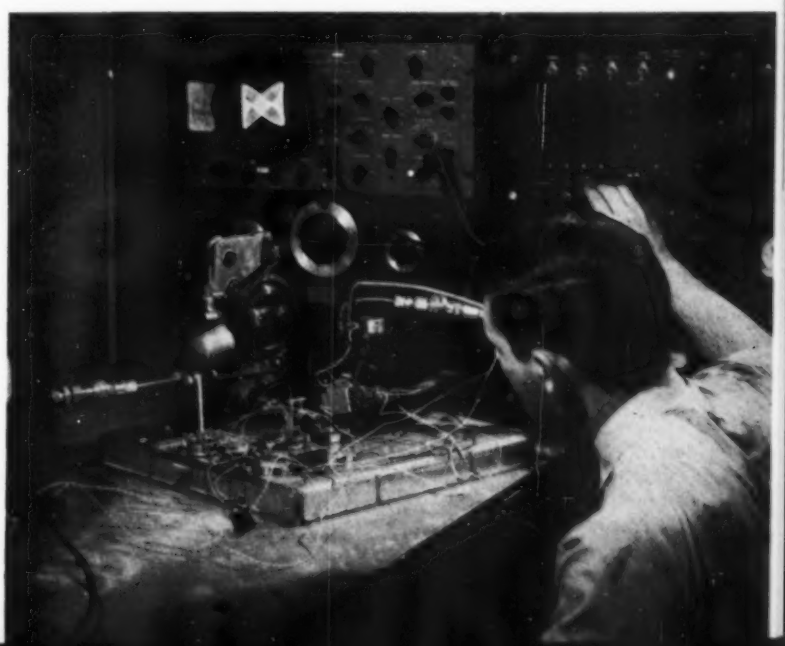
lot of unscientific fellows who would have no good records of what they had done, who could not separate their feelings from the facts and who would be unable to explain the reasons for their actions. The communication of ideas would be so difficult that nothing would be achieved. Our inventor would have to solve the problem himself. This he would try to do, but having spent so long in all the various unscientific problems of launching his enterprise, he would find his knowledge rusty and his thinking unsure. At the same time he would still have the enterprise to manage, the customers to persuade or mollify, new capital to raise and new designs to bring forward. He might hire a young renegade scientist to help, but the young man would have problems of communication too. He would not be accepted by the others in the company, he would not be familiar with the know-how, and his attempts to tamper with the machine, the basis of their livelihood, would be feared and resented, particularly by those who had high status because of their superior know-how and knowledge of the taboos. Eventually the originator of the machine would die and the bright young man would take his objectionable ideas somewhere else. The company would then emphasize its taboos and codify its know-how in precious little black books which would be kept in a safe place by a few, or perhaps only one, responsible man. It would coast slowly to its bankruptcy, sustained by excellent traditions and a generous policy to its employees. Its machines undoubtedly would have served a useful purpose, and salaries and dividends would have been paid.

Many companies have suffered such, or equivalent, fates, and the knowledge which they seemed to possess and which could perhaps have been made explicit, has passed into the lore with which our industrial society abounds.

Fortunately not all the natural philosophers retained such purity of spirit. Some were prepared to study machines as well as nature. The results of their study were particularly remarkable in the example of the steam engine. Carnot, Clausius, Kelvin, Rankine, and many others were interested in the steam engine because it posed the problem of how efficiently a heat engine could be made to convert the energy in fuel into mechanical work. Their attempts to understand it led to the formulation of the second law of thermodynamics and to the new thermodynamic concept of entropy. It should be a source of great stimulation to technologists that the most sweeping philosophical hypothesis of the Nineteenth Century was inspired by a machine. The same machine, in revolutionizing industry, transport, and power also started a social revolution. Our understanding of thermodynamics has led on to new inventions which, as they are manufactured, developed, used and studied, may in turn lead to profound new insights into the processes of nature. The calculating machine is a promising example, for the study and development of computing machines may one day lead us to understand our own processes of thought and even emotion. Certainly the study of machines is no second-rate intellectual activity. Philosophy may eventually owe as much to machines, let us say, as machines owe to philosophy.

So far I have tried to show that our industrial society owes its support and continuing progress to an intellectual activity which is now only about 200 years old. The intellectual activity in turn derives fresh vigor and new truths, sometimes of widespread significance to mankind, from a study of industrial processes and artifacts. I suggest that it is possible that a slowing down or stopping of what we call industrial progress might also slow down the intellectual activity which both supports it and is inspired by it. Humanity might then suffer a stagnation similar to that of the Dark Ages. Although this is too speculative a proposition to be defended in the large scene of a world-wide civilization, it certainly can be seen in those small groups which have failed to maintain a relevant intellectual activity and have slipped back to a primitive reliance on know-how and taboos.

M.I.T. Photo



The study of servomechanisms, as exemplified in this photograph in one of the Institute's laboratories, effectively integrates a wide range of engineering and scientific disciplines. Such integration helps to advance education in an industrial society; it helps remind us — "The fact is that all communities today are drawing their real power — the power which supports their commercial and political strength — from their industries, and particularly from those industries in which applied science and technology play dominating roles. We no longer live in a primarily agricultural or mercantile society. Ours is an industrial society."

Many industrial firms and some armies have suffered from such declines.

Such intellectual activity and its cycle of application and stimulus which I have described is not an easy thing to maintain. It requires social sanction. It decays if social support is withdrawn or is inadequate. It also requires people with the requisite knowledge and ability to perform the various tasks involved. We need scientists, pure and applied, if we must so divide them; we need engineers who must cover the ground between science and practice; we need many intelligent and able people who must inevitably but not necessarily disastrously for themselves or society, perform tasks in which know-how is their main guide. Although our industrial society cannot progress or even stay where it is without much intellectual effort, the main method now, as in the past, by which organizations execute their tasks is by teaching their members the know-how of the job. This is comparatively easy. I shall return later to the problems which dependence on unenlightened know-how may present.

To sustain our society we need adequate numbers of professionally trained people and adequate social support for their efforts. Until fairly recently both were forthcoming in sufficient quantity. But the last 30 or 40 years has seen such an increase in scientific knowledge and its application in industry that we are now in grave difficulties. Many industries are finding, consciously or unconsciously, that progress today depends on scientific work which has a degree of sophistication unbelievably greater than that thought necessary even a few years ago. In one important field, that of defense, the demands on science and technology have grown enormously both in sophistication and size.

There is some evidence that society is not prepared to support much more of the sort of intellectual activity which these demands imply. There are many ways of entering industry other than through the technological wicket. The prestige of finance, related historically perhaps to the paramount need for capital in the development of America, attracts many able young men and steers them away from science and technology. Their education follows the older, aristocratic tradition of the liberal arts. In England, industry and technology are not always the careers which attract the talented and best endowed. In a spirited editorial on the fact that the Russian output of university graduates in engineering is 60,000 per year, the American 22,000 and the British 3,000, the London *Times* (December 31, 1955) stated: "There is no call for unreasonable alarm. It would be a dangerous mistake for too much talent of the first order to be diverted into science and technology, because the strength of a democratic state depends on qualities in politics and administration which are still best fostered through a study of the liberal arts." The editorial favored instead more technical education for those going into, or already in, industry in technical and night schools throughout the country. Of course many of those who study liberal arts in a university enter posts in industry or government where they inevitably come into contact with, and even administer, the major intellectual activity of our industrial society. It is too much to hope that they can, by virtue of their liberal education alone, administer with more than moderate success an organization whose long-term future depends on intellectual processes with which they are not familiar.

The danger which our present educational policy presents is that it will develop an unbridgeable chasm between the scientists and technologists on the one hand, and those with a liberal arts education on the other. Perhaps this cleavage already exists. The increasing complexity of scientific knowledge and the methods of applying it will not reduce the gulf. The danger of a set of high priests in an industrial group, separated by a block in communication from those who are managing and operating the enterprise, but essential as intellectual leaders to its success, has been illustrated in the hypothetical example given earlier.

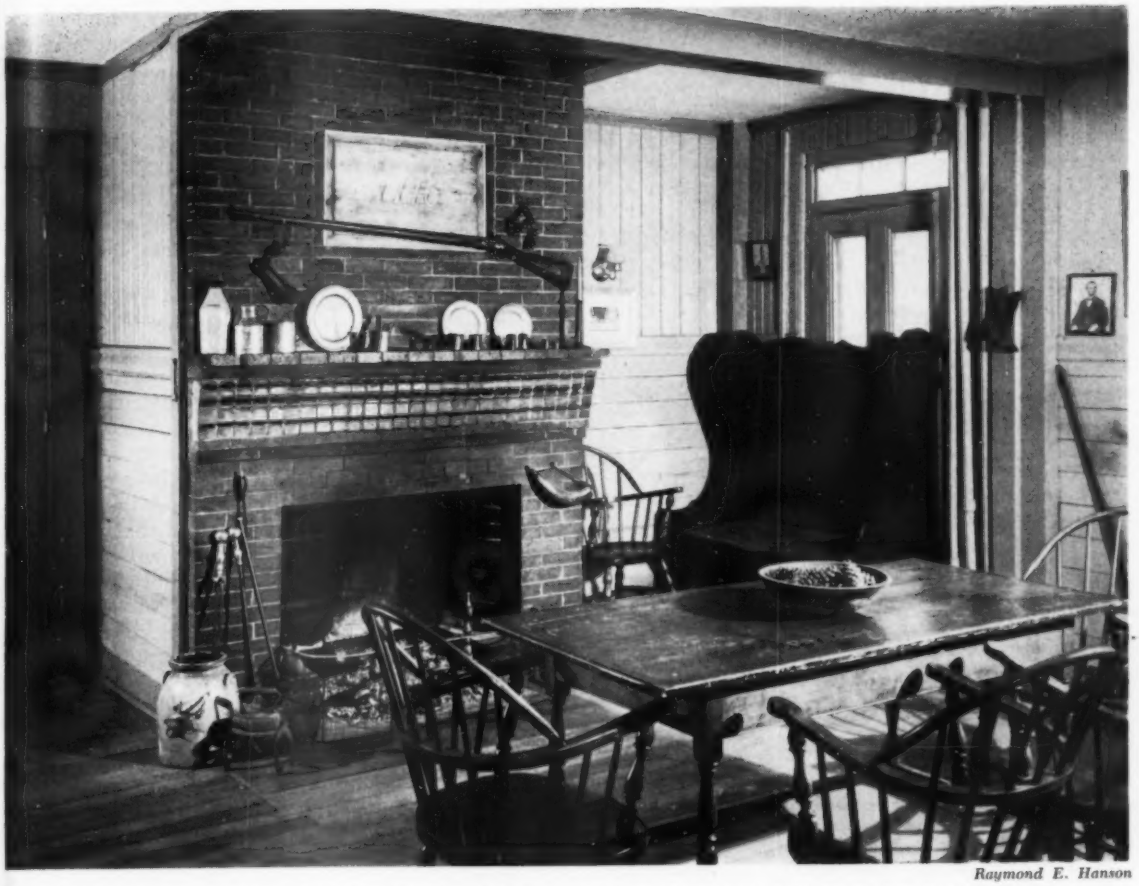
Our society is operated, managed, and vitalized by those in many walks of life. Their range of abilities and intelligence is vast. In the industrial core there are those who are guided by know-how working with imaginative engineers whose long schooling in science has equipped fertile minds. Between these there are gradations of knowledge and ability. An intelligent educated man who has no background of scientific schooling can operate in industry or on its periphery with many mental attitudes. He can fail to see the intellectual activity described and regard industry as merely a means of manipulating resources to make money or provide defense. If this is so, his education is surely at fault. He is unfamiliar with one of the vital ideas of our times. He can only, as Job said, darken counsel by words without knowledge.

Our educational program even for a liberal arts student must include a study of science extended over the years of school and college. I would select physics as the subject because it has the elements of precision and romance which were so valuable a feature of Latin — a subject which is now lost to us as an educational medium. I would tend rather naturally to emphasize the applications of physics and its history. The study of application, in the form of some aspect of engineering, has the advantage that it relates the abstractions of science to the realities of manipulation. About eight years of physics taken at not too fast a pace is not an unreasonable requirement for anyone who pretends to be an educated man in 1956! It may be an unreasonable requirement in terms of teaching facilities at schools and colleges.

It is necessary to spend some time on science if we are to pass successfully through Whitehead's three phases of education, the romantic, the disciplinary, and the integrating. To stop at some intermediate stage would rob the pupil of the reward for his efforts, for it is in the last phase, when he is able to appreciate the pattern of knowledge, that intellectual vision comes. Then he acquires an understanding of the subject, supported by organized ideas and relevant techniques, which will enable him to live more fully in this new epoch.

The arrangement of such a syllabus, the provision of teachers and facilities, is no easy task. There is also the question of the aptitude of the pupils. Physics,

(*Continued on page 212*)



Raymond E. Hanson

The Thoreau Room of the Colonial Inn at Concord, Mass. gives some hint of the food technology of the colonial era.

Kitchen Revolution

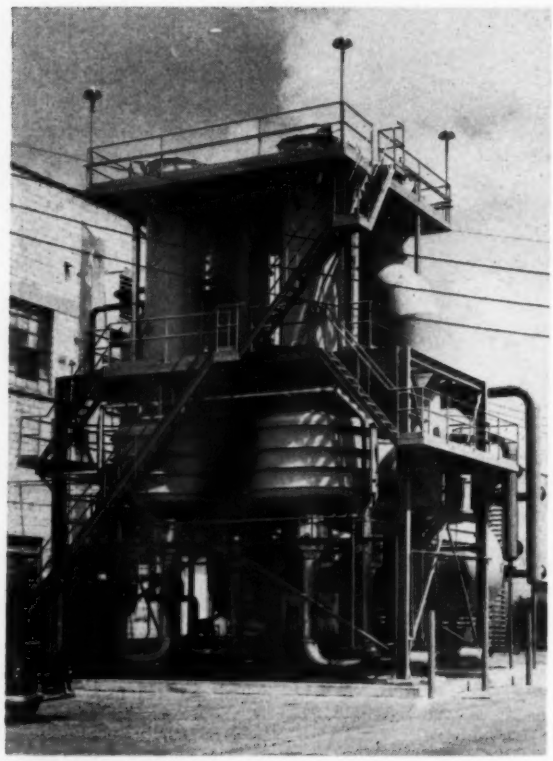
The preparation of man's food has changed drastically as boundaries of technology are forever pushed ahead

by HARRY W. VON LOESECKE

It was a large room. One side was nearly completely taken up by a cast-iron stove, nickel-plate trimmings gleaming, and its massive bulk polished to the brightness of very new patent-leather shoes. Tucked underneath the stove was a battered scuttle, half filled with coal. Several pots on the stove were spouting steam, and within the dark maw of an oven, rested several pans of bread and pie, their sweet aroma permeating the moisture-laden air which coated windows and walls with a dewy blanket. Opposite the stove loomed a clumsy soapstone sink with brass piping, piled high with pots and dishes waiting to be scrubbed with hot water from the tank hanging like a miniature swimming pool at one end of the stove. In the far corner of the room was a heavy table draped with a red oilcloth. A few high-back chairs were nearby and tucked away out of the main lane of travel. The floor was covered with a flower-design linoleum, nearly worn through in front of the stove and sink. Leading off the room, was a smaller one provided with a counter, and walls lined with wooden cabinets stacked full of pots and pans and all qualities of dishes.

This was a kitchen of 50 years ago where mother spent most of her waking hours, either preparing the next meal, or cleaning up from the last. Her lot was one that today's mother would neither tolerate nor could long endure.

The cooking stove of that era would seem a Frankenstein according to our present standards:



U.S. Department of Agriculture

Low-temperature evaporator for making frozen concentrated orange juice, of which more than 60,000,000 gallons were produced in 1954. The equipment shown can evaporate more than 3,600 gallons of water per hour.

"Outside the modern accessories of warming oven, water tank, front or coil, the common cooking range consists of a rectangular iron box divided into three compartments, viz., fire-box, ash-box and oven . . . the fire is regulated and controlled by dampers; these admit air to the burning fuel, check the strength of the draft (of air) and control circulation of heat about the oven."* Sears, Roebuck sold such a stove for $12.50.

In those days that are now but an afterglow, mother did not rush home from work, seize the can opener and be off to an evening's entertainment with father in another half or three quarters of an hour. Indeed not! The evening meal was sort of a ritual and the climax of a busy and happy day. "At night, there can be no excuse for an indifferently prepared meal; everything can be made ready in the early part of the day and the final cooking completed without the rush and hurry incident when other work is going on."†

During this leisurely repast, we should "let the brightness of the day that has come to us, the lively sayings that we hear cheer the hours of the meal time, and, lest we miss some good thing that will bear repeating, let us cultivate the habit of looking for brightness everywhere."†

Many of the dishes served required a considerable amount of skill, and unless mother was something of a culinary artist, the results of her labors were often disappointing. Even the preparation of a pot of coffee amounted to a major project: "In a coffee-pot that has been well-scalded put twice as many tablespoonfuls of ground coffee as there are cups to be served; add as many egg-shells, washed before the eggs were broken, as there are cups to be served; or the white of an egg may be used, that of one egg being sufficient to clear about seven tablespoonfuls of ground coffee. Add a tablespoonful of cold water for each cup of liquid desired, and mix thoroughly, add the requisite number of cups of freshly boiling water and let boil 5 minutes after boiling begins. Pour a little cold water – from a quarter to half a cup – down the spout and set the pot where it will keep hot, without simmering, for 10 minutes. The aroma is thought to be retained by filling the nozzle with tissue paper, before the boiling water is poured over the coffee."‡ At this point, if father has been delayed and is not ready for his coffee, then mother is in for some more alchemy. The decoction must be poured from the grounds, the pot cleaned, the coffee returned to the pot, kept hot and then an additional teaspoonful or more of fresh coffee added "for the sake of aroma."

Contrast this procedure with that used now, when a cup of coffee can be made by merely dissolving a teaspoonful of soluble coffee in a cup of hot water. Having a dim origin in the closing days of the Civil War, soluble coffee did not catch the consumer's fancy until World War II, and today over 20 per cent of all coffee consumed in the United States is made from soluble. This growth in use is due to marked improvements in quality and solubility brought about by advances in chemistry and engineering during the past few years.

The housewife today has few of her forebears' tiring chores of washing, peeling, plucking, soaking, shelling, and juicing; nearly all of these tasks have been taken over by the processor. Instead of spending 90 per cent of her time in the kitchen wrestling with a temperamental stove and mounds of dirty dishes, she spends about 30 minutes per meal. Probably at least one third of the food expenditures of urban housekeepers is for bread and other baked goods and ready-to-serve cereals, for cooked and canned meats, poultry and fish, for canned and frozen vegetables, fruits and juices, for jams and marmalades, soups and other partially prepared foods.

This kitchen revolution and emancipation of the housewife has been the result of the impact of technology on modern society. There has come about an increase in the percentage of married women with outside jobs, because in many families income has not kept pace with rising prices and it has been found imperative to have another wage earner. Then, too, the prestige of being a good cook is smaller than it used to be. Success of the revolution has been made possible by advances in food technology and engineering with the creation of new products for the convenience of the consumer.

* Janet McKenzie Hill, *Practical Cooking and Sewing*, page 2 (New York: Doubleday, Page and Company, 1909).

† Hill, *op. cit.*, page 703.

‡ Hill, *op. cit.*, page 49.

Charles G. Mortimer, President of General Foods, refers to these products as containing "built-in maid service."

One of the more recent and perhaps most successful foods with built-in maid service is frozen concentrated orange juice. Each six-ounce can of this concentrate contains the juice equivalent of about four and one third pounds of fresh oranges, and will make one and one half pints of orange juice. The housewife prepares the finished juice by merely adding three cans of cold water to the contents of the can; there is no reaming of the fruit, cleaning up afterwards and disposing of the peels. Over fifty times as much frozen concentrate is sold today as was sold eight years ago. Yet this product would not have been possible without the development of automatic juicing equipment. Twenty-five years ago oranges were juiced by hand labor in citrus processing plants, one man being able to produce between 10 and 15 gallons of juice per hour. On this basis, it would require a labor force of approximately 2,500 people to extract enough juice to keep one of the modern citrus processing plants running one day. One automatic juice extractor can now produce in one minute as much juice as one man formerly extracted in an hour.

Another development that made frozen concentrated orange juice possible was the engineering of low-temperature evaporation. Although concentrated fruit juices have been known for many years, they suffered flavor damage during evaporation, even though water was removed under a high vacuum. Today juice is still evaporated under a high vacuum, but steam is no longer the chief source of heat. Instead, the heat obtained by compressing ammonia gas is used, because this offers better temperature control. After some of the heat of the compressed ammonia is used, it is allowed to expand and the cold ammonia used to condense the vapors boiling from the juice under vacuum. Two or more separate evaporators may be hitched together in series with the economy of using the vapors from one evaporator to heat the liquid in the succeeding one, an old trick in sugar boiling. Vapors from the last evaporator in the series may be recompressed and used for heating, thus effecting further economies.

Fresh orange juice can also be purchased in paperboard cartons in the same manner as fluid milk, and at a cost comparable to frozen concentrated orange juice. Fresh juice is being produced in California and Florida and shipped in refrigerated trucks. Present production in Florida alone amounts to about 20,000,000 to 40,000,000 gallons a year.

Recent engineering advances by research workers of the U.S. Department of Agriculture have shown that orange juice can be dried without loss of flavor or nutritive value. And the product can be stored without refrigeration. Although many attempts have been made in the past to dry orange juice, the product failed to keep when stored at room temperature. The chief reason for this was the comparatively high (about 3 per cent) moisture content of the dry product. Material containing 1 per cent or less moisture was found to be stable on storage at room temperature. But it would be too expensive to dry orange juice to this low moisture content in any type of commercial drier. Then a scientist of the U.S. Department of Agriculture came up with the idea of doing the final drying in the packaged orange juice itself. This was called "in-package desiccation." It works like this: as the orange powder comes from the drier, it contains about 3 per cent moisture which is reduced to less than 1 per cent by packing the powder into the final hermetically sealed container along with a small envelope containing lime. The lime takes up the moisture from the powder while it undergoes a conditioning period of from 60 to 90 days at room temperature. By the end of this time, moisture has been reduced to the point where the powder can be stored at higher temperatures without deterioration. Orange and grapefruit juice powders are now being produced in Florida.

The modern housewife need no longer be concerned with the often laborious task of preparing fresh vegetables for the table. In many instances, she can purchase fresh vegetables, ready for the table, in plastic sanitary containers. Pre-peeled potatoes, for French fries, can be obtained; production of this type of potato now amounts to more than 145,000,000 pounds a year.

In some instances, frozen vegetables have entirely replaced the fresh commodity, and annual per capita consumption of the former has increased from 0.4 pound in 1937 to about eight pounds in 1955. It has been estimated that by 1960, 10 per cent of all food purchases by the consumer will be frozen foods. The number of frozen products, and particularly precooked frozen foods, has increased tremendously during the past five years, and today there are close to 100 such foods for the convenience of the homemaker. About $1.00 will buy a complete precooked turkey dinner consisting of turkey, potatoes, and a green vegetable, suitably garnished with butter, gravy, and spices. All that is necessary is to warm the dinner in the oven. There is no dishwashing after the meal, for the plate is thrown away.

The widespread consumer acceptability of frozen foods has been brought about by years of research by the chemist, bacteriologist, and engineer. The successful freezing of vegetables has been accomplished during only the past 25 years. It was said that it could not be done, because every farmer knows what happens when a frost blankets his vegetable crop. As the warm sun defrosts the vegetables, they rapidly deteriorate. Results of research in the freezing of vegetables seemed to substantiate what the farmer already knew, and there was loss of quality during freezing and storage. Then it was found that if the vegetables were blanched (that is, heated in steam or hot water for a few seconds) prior to freezing, unfavorable changes no longer took place, or were at least retarded. Apparently the heat inactivated certain enzymes which otherwise would bring about deterioration during frozen storage. The enzymes of fruits are not usually inactivated by heat before freezing, because heating changes the appearance, texture, and flavor of the fresh product. Sugar is therefore commonly used to protect frozen fruits and retard undesirable changes which might otherwise be brought about by enzyme action.

(*Continued on page 216*)

The Wake of the Red Plague

Therapeutics has succeeded in causing its decline where law and education have been less successful

by JAMES A. TOBEY

As a monarch, Charles VIII of France was insignificant; as a military commander he was inept, and as a man he was weak. This feeble king was, nevertheless, more or less responsible for one of the most momentous events of history, the terrible outbreak of the red plague at the end of the Fifteenth Century. Why it occurred and where it came from is still one of the great mysteries of medical science.

Charles was the only son of the Spider King, the crafty and epileptic Louis XI. He came to the throne in 1483 at the age of 13, with his sister, Anne of Beaujeu, acting as regent until 1492. In 1491 Charles married Anne of Brittany, by whom he had four children. The oldest of these, the Dauphin, died of smallpox in 1495 at the age of four, while each of the other three succumbed shortly after birth. With them ended the House of Valois, rulers of France for a century and a half, since Charles died suddenly in 1498 at the untimely age of 28.

Having a shadowy claim to the throne of the kingdom of Naples through his grandmother's House of Anjou, Charles decided in 1494 to invade Naples and then proceed to the conquest of Constantinople, incidentally making himself emperor of the East. For this noble purpose he gathered a band of mercenaries and dissolute adventurers from all over Europe, including some of the former mariners from the recent expedition of Columbus to the Americas. Accompanied by a horde of camp followers, this profligate mob marched across Italy, pillaging and raping as they went.

In February of 1495 Charles and his vagabond army entered Naples in triumph, having encountered little opposition on the way. There he remained for three months, gaining little glory and much booty. A coalition was, however, formed against him and this, together with a disastrous epidemic among his troops, caused the king to beat an ignominious retreat. When the forces reached the borders of Italy, they scattered in all directions, and with them went the wake of the red plague. By the end of 1497 this pestilence had spread all over Europe.

This horrible disease was something new and startling, something which the doctors of the time apparently never had seen before. The French called it *la grosse verole*, or great pox, in contradistinction to *la petite verole*, or smallpox. They also called it the mal de Naples, but the Neapolitans patriotically retaliated by naming it the French disease. In England it was known as the Spanish disease, in Russia as the Polish disease, and in Persia as the Turkish disease. In the early days of the American Colonies it was the French disease, and it still is occasionally referred to as *morbus Gallicus*.

Actually this malady was syphilis, but in a form more malignant and more epidemic than has ever been encountered before or since that time. The name "syphilis" did not come into being until after 1530, when an Italian physician, one Girolamo Fracastoro, wrote a poem about an innocent shepherd named Syphilus, upon whom the disease was said to have been inflicted by Apollo as punishment for homage to the king instead of to the god. This poem, which outlines symptoms and treatment in some detail, was not the first on this dubiously poetical subject, for an ode on *Las pestiferas bubas* had been composed by Francisco Lopez de Villa-lobos, as early as 1498.

Unlike modern syphilis, which is a relatively benign disease, although dangerous if untreated, this Fifteenth Century form of it was virulent in the extreme. It usually began with the characteristic ulcer on the genitals (chancre) and swelling of the lymphatic glands (buboes), but was rapidly followed by a pustular eruption over the body from the head to the knees, with ulcerations and crusts which presented a most loathsome appearance, so that even lepers shunned these disgusting patients. Extensive loss of tissue occurred, along with painful swellings on the bones, and various other unpleasant symptoms, which persisted for years if the patients were fortunate, or perhaps unfortunate, enough to survive. The death rate in this epidemic was high, unlike that of modern syphilis, which is very low.

Source Is Controversial

The source of this historic outbreak is a matter of great controversy. Apparently syphilis did not exist in antiquity, at least there is no evidence of it in the bones of Egyptian mummies and other ancient human remains. In many venerable documents can be found references to ailments of the genitals, but these "sacred fires" are thought by most experts to have been gonorrhea, soft chancre, or nonvenereal ailments, rather than syphilis. Not until the early part of the Nineteenth Century (1838), in fact, were gonorrhea and syphilis differentiated as two separate and distinct diseases; prior to that time they were considered as different symptoms of the same malady. Although there are plenty of references in ancient documents to skin lesions which resemble those in the later stages of syphilis, these could easily be confused with other conditions, such as leprosy, lupus, scabies, St. Anthony's fire, and yaws.

(*Continued on page 206*)

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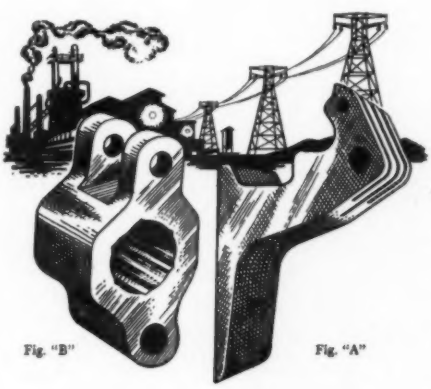

Fig. "B" Fig. "A"

Before arriving at the selection of the Revere Aluminum Extrusion (Fig. "B"), also used in the same circuit breaker, various metals and their properties were studied. First, an aluminum casting was thought to be the answer. Then it was found that an extrusion would weigh less and have a higher strength ratio than a casting. So, by using an aluminum extrusion, both space and weight were saved. Here is an example of where a material costing a little more per pound saved money in the end.

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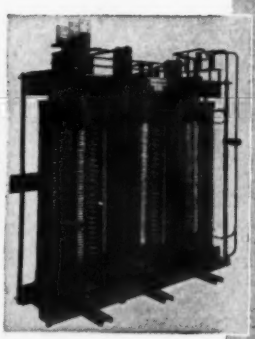

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WAKE OF RED PLAGUE

(*Continued from page 204*)

The syphilis of the Fifteenth Century had appeared first in the City of Barcelona in Spain in 1493, shortly after Columbus returned from his voyage to America, even while the admiral was making his fervid report to Ferdinand and Isabella in this city. Many of the Spaniards infected with the painful buboes had joined the army of Charles VIII in the following year, and thus may have communicated the disease to the main body of this army.

Did the crew of Columbus bring back this so-called "Indian measles" from the West Indies as a grievous gift to the people of Europe? One school of historians has answered unequivocably in the affirmative, but there is reasonable doubt in the matter. A malady known as guaynaras, unquestionably syphilis, had existed among the natives of Hispaniola from remote times, so long in fact that the natives had developed a system of therapy for it, including the use of guaiac, balata, and other vegetable remedies, the regulation of the diet, temporary abstinence from intercourse, and other rigorous measures. From contemporary accounts we know that members of the crew of Columbus had intimate relations with the alluring brown maidens of Hispaniola and that many became infected with guaynaras. In the West Indies the disease was mild, but it became more violent when it reached Spain, so much so that a local physician, Ruiz Diaz de Isla, called it the "reptilian disease," and wrote a book about it.

Medical Historians Examine Evidence of Origin

Other Spanish writers of the period who spent much time in the New World, such as Oviedo and Las Casas, were likewise convinced of the American origin of syphilis. Since that time numerous leading medical historians have examined the evidence in great detail, with the result that some espouse the theory of the American origin of the red plague, while others are equally certain that syphilis in a mild form was present in Europe long before the ill-fated campaign of Charles VIII, and that for some obscure biological reason it burst forth in virulent form in 1495. Certainly, venery and promiscuity, along with war, had been common in Europe for many centuries before this time. During the lax morality of the Middle Ages, the people may have become saturated with a mild type of syphilis and perhaps may have developed a resistance to it, although there is no immunity to modern syphilis. One argument that can be advanced against the American origin of the disease is the comparatively short time between the return of Columbus and the outbreak of the epidemic.

Although no less an authority than the late Sir William Osler favored the American origin of syphilis, the matter is and probably always will be in dispute. Osler, incidentally, called syphilis the "Great Imitator," because in its later stages the effects imitate those of so many other serious maladies. Many an illustrious monarch, from the time of David through the Roman emperors, the kings of France

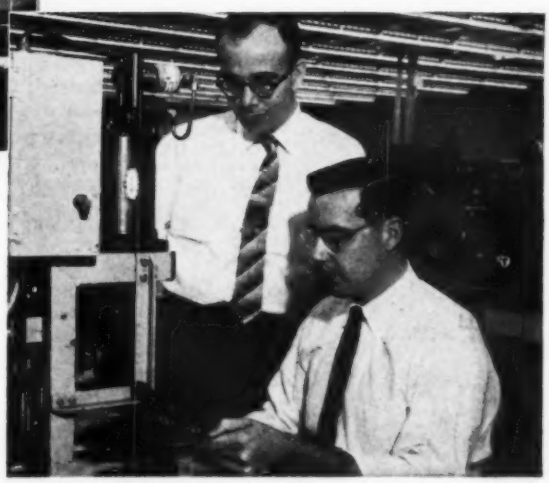
(*Continued on page 208*)

Meet Bill Hancock

Western Electric development engineer

Bill Hancock is a graduate of Pennsylvania State University where he majored in industrial engineering. Bill joined Western Electric as a planning engineer in November, 1951, at the Kearny Works in New Jersey. Later, he was assigned to the new Merrimack Valley Works in North Andover, Massachusetts, as a development engineer. Here Bill is shown leaving his attractive New England home for his office while his wife, Barbara, and their daughter, Blair, watch.

Bill's present assignment at Western Electric: the development of methods and machinery for assembling one of today's most promising electronic developments – electronic "packages" involving printed wiring. At a product review conference Bill (standing) discusses his ideas on printed wiring assemblies with fellow engineers.



Bill and his supervisor, John Souter, test a machine they developed to insert components of different shapes and sizes into printed wiring boards. The small electronic packages prepared by this machine are being used in a new transistorized carrier system for rural telephone lines.

Sailing off the north shore of Massachusetts is one of Bill's favorite sports. He also enjoys the golf courses and ski runs within an easy drive from where he lives and works.

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WAKE OF RED PLAGUE

(*Continued from page 206*)

from Hugh Capet onward, and so on down the ages, have displayed symptoms such as paresis, locomotor ataxia, skin diseases, lung and heart and kidney diseases, and other afflictions which might well be attributed to syphilis contracted in youth and allowed to progress without adequate treatment. Such symptoms in prominent persons indicate that syphilis existed long before the American adventure of Columbus.

The epidemic of the Fifteenth Century was not confined to common soldiers, sailors, and camp followers, but soon spread to the gentry and nobility. Among the victims of the great pox were Francis I of France, Henry VIII of England, the Borgias and the Medici, Ivan the Terrible in Russia, and numerous other well-known figures in the political, ecclesiastical, and cultural life of the times. In one of his campaigns against his rival, Charles V of Spain, Francis enlisted the aid of the infidel Sultan of Turkey who sent the notorious pirate, Barbarossa, to the aid of the French king. The buccaneer, well acquainted with syphilis, brought to Francis his favorite remedy, consisting of crude mercury mixed with rhubarb, ambergris musk, wheat flour, and lemon juice. The nostrum proved ineffective in this case, probably because it was too late.

Mercury had been advocated in the treatment of syphilis by de Isla and others as early as 1500, and it remained in vogue for this purpose until 1910, when Dr. Paul Ehrlich prepared the arsenical compound, salvarsan, on his 606th attempt to find a specific against the Spirochaeta pallida, which had been discovered by Dr. Fritz Schaudinn in 1905. This spiral-shaped organism is now known scientifically as the Treponema pallida. A member of the same family of microbes, the Treponema pertenue, causes yaws, a nonvenereal tropical disease which resembles syphilis.

Despite the tremendous havoc created by the red plague at the end of the Fifteenth and the beginning of the Sixteenth Centuries, its vehemence gradually died down. Within 50 years of this first outbreak, when Fracastoro published his classic *De Contagione* (1546), syphilis had become much milder. It has continued in this category up to the present time, and today actually seems to be on the way out, thanks largely to new and improved methods of treatment.

Syphilis has been endemic in the United States since the earliest colonization, and always has been one of our most important public health problems. Except for some grave shaking of heads, not much was done about it until 1906 when an ardent reformer, Dr. Prince A. Morrow, organized the Society for Sanitary and Moral Prophylaxis, which subsequently became the American Social Hygiene Association under the able direction of the late Dr. William F. Snow. In 1911 Dr. Snow, as State Health Officer of California, had been responsible for mak-

(*Concluded on page 210*)

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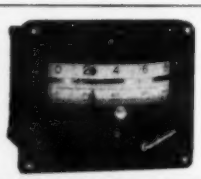

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WAKE OF RED PLAGUE

(*Concluded from page 208*)

ing syphilis and gonorrhea reportable diseases, a drastic innovation soon followed in other states. Due to a false sense of delicacy in the early days, these reports often were by number rather than by name, which offered nice opportunities for statistical analyses, but not much else. During World War I federal and state legislation against the venereal diseases, much of it stimulated by Dr. Snow and his Association, was greatly intensified.

After 40 years or so of fervent educational and legal campaigns against the venereal diseases there was, however, no appreciable decline in the incidence of these maladies in the United States. A one-day survey of a representative sample of the population, made by the United States Public Health Service in 1927, revealed about four cases of syphilis per 1,000 population in the white and nearly double that in the nonwhite. A repeat survey in 1930 indicated an even higher rate.

Successful Therapeutics

With the advent of new chemical methods of treatment, such as the sulfa drugs, and new antibiotics, such as penicillin, the situation began to change. In the last 10 years there has been a most gratifying decline in the morbidity and mortality of the red plague, therapeutics having succeeded where law and education had been less successful. The death rate from syphilis, at all ages for example, has been reduced by about 70 per cent, and that in infancy by 95 per cent. The premarital health examinations and blood tests which are now required by law in 40 states uncover, in many areas, only about one case of syphilis in 10,000 examinees, and doubt is being expressed as to the present scientific and economic justification for these tests, although certainly they were valuable 20 years ago.

The decline in the incidence and severity of syphilis does not mean that the venereal diseases have been conquered in the United States. It is reliably estimated that in 1953 there were about 150,000 reported cases of syphilis, and about 250,000 reported cases of gonorrhea in this country. How many unreported cases there were is anybody's guess, but the number probably equaled, if it did not exceed, the reported. The wake of the red plague may be diminished, but it is still with us.

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Kenneth J. Faucett, Jr.
1952
David Lee
1946
Manford Markowitz
1951
Charles E. McGinnis
1954
R. R. McPherson
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R. M. Oliver
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Clair F. Parker, Jr.
1951
E. O. Parker
1942
George Sebestyen
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S. Smith
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S. M. Sussman
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David VanMeter
1943
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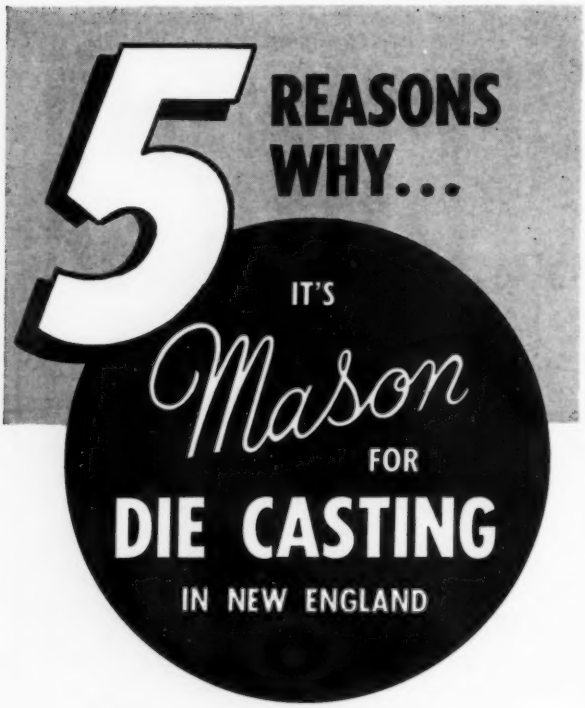

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EDUCATION FOR INDUSTRIAL SOCIETY

(*Continued from page 200*)

for instance, is not a subject which one can appreciate fully without algebra, and algebra is a stumbling block for some. It may well be that algebra suffers from the fact that in many educational programs it leads nowhere. The interest in algebra would be heightened if it led into science. Science would become more interesting and more easily taught if teachers themselves believed that it formed part of the knowledge without which no modern child can develop foresight and wisdom.

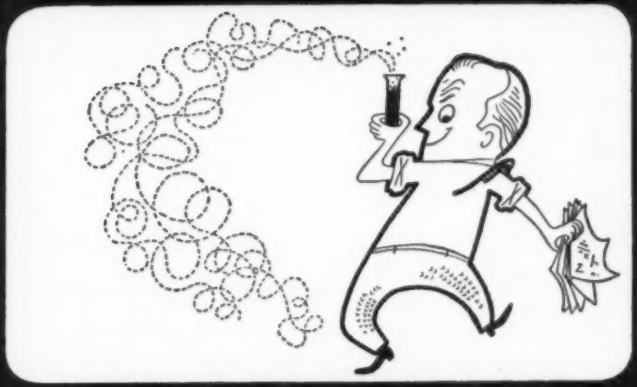
The key to education lies not only in the curriculum but even more with the teachers. It would undoubtedly be a mistake to force a new schedule of science courses for all pupils, if those who taught it did not understand the true purpose of their activity. Pupils are guided by their teachers and tend to accept their evaluations. This is what we mean when we say a teacher should inspire his pupils. It is difficult for a teacher brought up in a liberal arts tradition to regard science as other than a special subject or industry as other than a merely mechanical and commercial activity. Almost no teachers in general education have had any experience of industry at a level where the intellectual aspects of the technological process become apparent. They will often have to search hard in industry to find the creative intelligence at work, for it is not revealed to the casual visitor.

Teachers also may have difficulty in relating the activities of the industrial groups around us to the culture of the past. In some respects these groups are like primitive tribes. In spite of all their files and reports they have little or no written history. Their habits often bear the stamp of those societies in which the struggle for existence dominates all else. Their social structures are established around their work. Job and status are closely related. When the development of some new technology changes or makes obsolete the job, status and social structure also change, often with painful effects. The conflict between the natural desire to stabilize a social structure and the need for adapting it to technical innovations is discernible in industry today. On large or small scale, it presents the sort of raw material from which the student of the humanities has learned to construct a picture of man and his history. The struggle is interesting not only because of historical parallels, but also because the rate of technical innovation is now so great the social structures may rise and decay in a lifetime or less.

The process by which our sophisticated scientific knowledge fertilizes and gives life to our industrial activity is so subtle that most of those who work in industry are unconscious of it. The changing culture of a factory – to use the succinct title of Elliott Jaques's industrial research – is obscured from those who live in it as actors concentrating on their roles. It is for this reason an excellent suggestion to make special arrangements when teachers visit industrial establishments. In such visits they should be able to see not machines cutting metal but men making de-

(*Concluded on page 214*)

Do you have a process that needs a plant?



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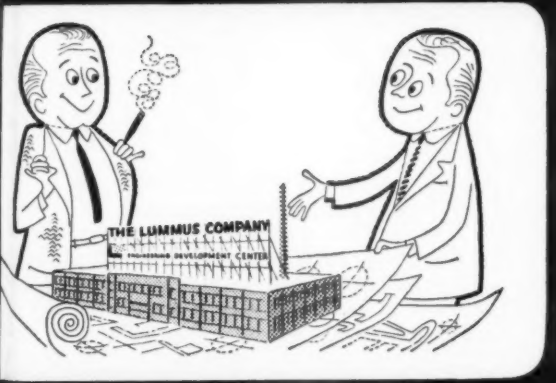

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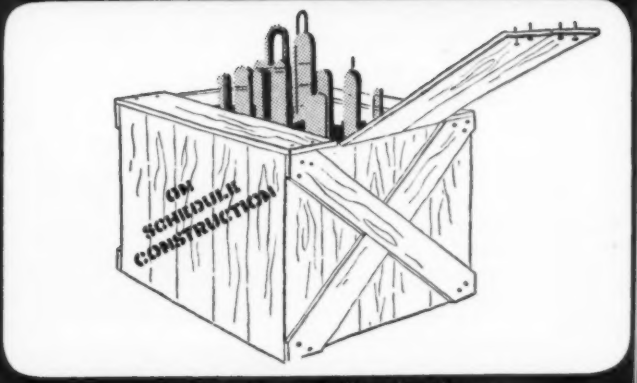

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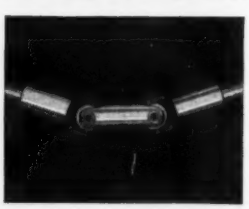

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EDUCATION FOR INDUSTRIAL SOCIETY

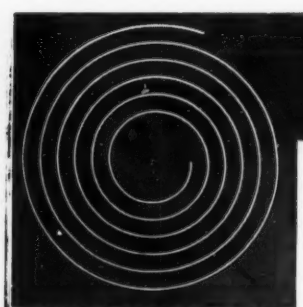
(*Concluded from page 212*)

cisions. They should be shown the way in which the company thinks – however ashamed the company may be of its thinking processes – rather than what the company makes and what equipment it uses. There will be much evidence of the financial and commercial thinking but somewhere, if he is patient, the teacher may find someone who keeps alight a spark of the intellectual activity which started us on the road to trains and thermodynamics, to electric lamps and the theory of communication, to airplanes and control. On his way back to the classroom our teacher will realize that he has had a glimpse of the process which has changed not only our surroundings, but also our ideas. It will be the task of his pupils to keep alive the creative energy of our industrial organizations and to transfer to them the high ideals of the past.

The need for a new effort to adapt our education to meet the impact of technology and science has long been recognized. Forty years ago A. N. Whitehead, before the Mathematical Association in England, stated it as follows:

"When one considers in its length and in its breadth the importance of this question of the education of a nation's young, the broken lives, the defeated hopes, the national failures, which result from the frivolous inertia with which it is treated, it is difficult to restrain within oneself a savage rage. In the conditions of modern life the rule is absolute, the race which does not value trained intelligence is doomed. Not all your heroism, not all your social charm, not all your wit, not all your victories on land or at sea, can move back the finger of fate. Today we maintain ourselves. Tomorrow science will have moved forward yet one more step, and there will be no appeal from the judgment which will then be pronounced on the uneducated."

In response to the need, we must arrange to teach science effectively to as many as possible. We must interest our teachers in the industrial process by which we live. We must value the intellectual cycle which leads from ideas to machines and thence to ideas again. This combination of instruction, inspiration, and social support will be enough. The need for specialists may then be met without strain. Furthermore we shall liberate the creative energies of our people and, by so doing, raise our society to higher levels of achievement and culture.



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KITCHEN REVOLUTION

(Continued from page 203)

Dehydrofrozen foods, the result of research by scientists of the U.S. Department of Agriculture, are new products with which the housewife comes in contact only indirectedly at present, for they are sold to food processors who incorporate them into their products. Thus, many of the pimientos used in pimiento cheese are dehydrofrozen. The technique of dehydrofreezing is similar to conventional freezing procedures, except for a dehydration step interposed in the processing sequence just prior to packaging and freezing. Dehydrofreezing is designed to retain the advantages of both dehydration and freezing while eliminating, as far as possible, the disadvantages of each. Usually, the product is dehydrated to a 50 per cent weight reduction, then frozen and held in the same manner as frozen foods. Present production of dehydrofrozen foods consists of apples, apricots, pimientos, peas, carrots, and lima beans.

Dehydrated foods have chiefly been thought of as a wartime expedient for better transportation and less storage space. But today, the housewife is making use of many dehydrated products to ease her kitchen duties.

In 1945, during World War II, over 93,000,000 pounds of dried eggs were produced, mainly for military purposes. So far as the G.I. was concerned, these 93,000,000 pounds could well have been dumped into

(Continued on page 218)

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KITCHEN REVOLUTION

(*Continued from page 216*)

the sea without being missed as an article of the die The product was far from satisfactory. But the pi ture is different today. Research, both in Englan and the United States, has shown that one of the re sons for the impossible taste of dried eggs, was chemical reaction between the sugar and the pho pholipids in the eggs. It is easier to remove sug than fats, and this is done by fermenting the suga with yeast or certain bacteria, or breaking it dow with enzymes. Eggs so treated remain quite stabl when dried and are being used in dry cake mixe and will even make a satisfactory scrambled egg o omelet.

Dehydrated potatoes that can be served as mashe potatoes by merely adding hot water or milk are o the market, and about 25,000,000 pounds were pro duced in 1954. The technique of production is mor than simply powdering dried potatoes. Grinding rup tures the cell walls releasing the starch, and th mashed potatoes will have the consistency of wall paper paste. However, if the potatoes are mashe when they have a moisture content of 40 to 50 pe cent and then dried, there is very little cell ruptur ing and the dehydrated product can be whipped t give an acceptable mashed potato. To accomplish economical production of instant mashed potatoe on a commercial scale, required the application o considerable engineering science.

Dry nonfat milk solids have been on the marke for years, but did not enjoy widespread use, chiefly because of difficulty in dispersing the product i water. A readily dispersible product is now available brought about by the application of physical chem istry. Although details have not been revealed, it ca be speculated that the process probably depend upon crystallization of lactose (milk sugar) in the alpha hydrate form. When this happens, the milk will cake and this cake can be ground and excess wate removed to the point that the product will keep.

Among other dehydrated commodities besides milk, whey, coffee, fish, leavening yeast, fruits and vegetables – all familiar to the modern housewife – there are less familiar articles, such as molasses, honey, sugar sirups, steaks, small roasts, chops, salad dressing, vinegar, hard curd cheese, and beer. The last named is considered by many technologists as being only of academic interest at present.

(*Concluded on page 220*)

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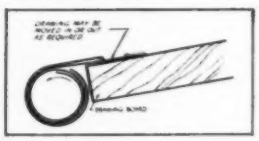

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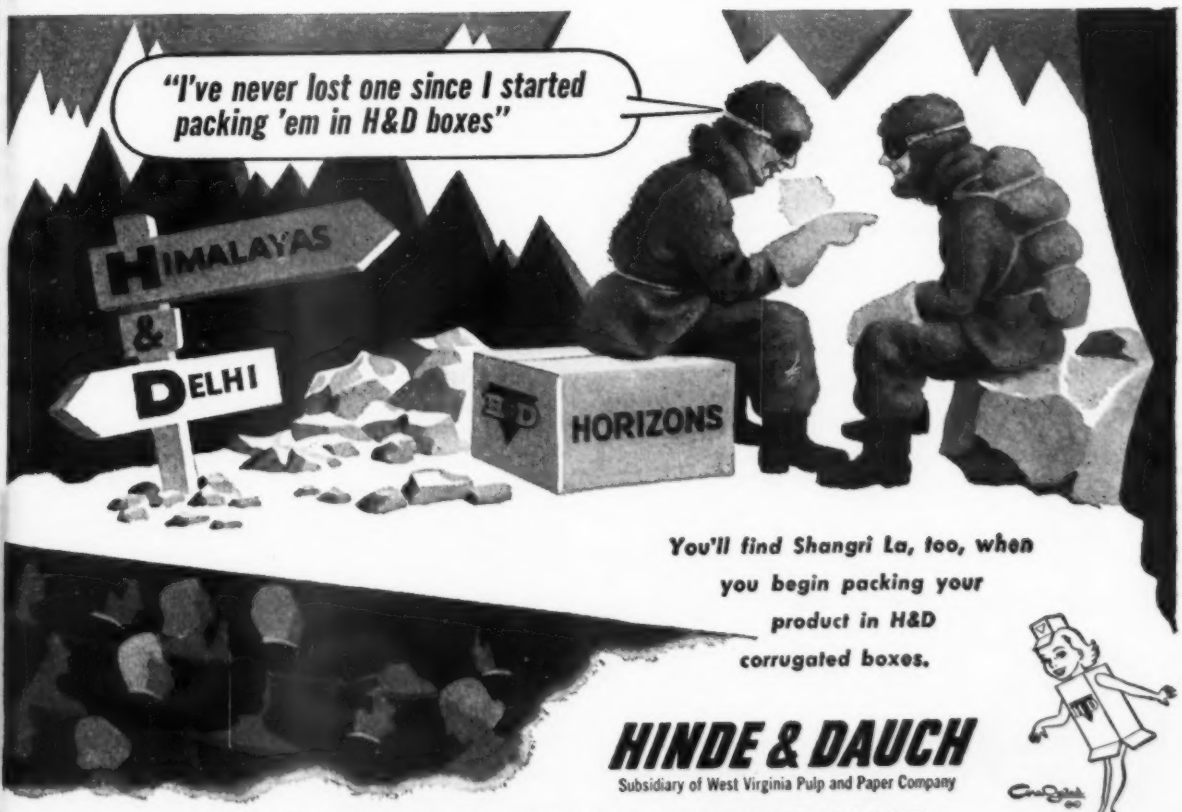

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KITCHEN REVOLUTION

(*Concluded from page 218*)

How often our thoughts go back to the winter evenings of our childhood, when the old corn popper was taken from the kitchen cupboard and filled with just the right amount of corn. If you added too much several unpopped kernels would be left and the puffed kernels would scorch. Then the popped kernels would be put into a big bowl with melted butter and salt, ready to serve the family. After it was over mother would gather up the greasy dishes and take them to the kitchen to be washed, while we went up to bed with a satisfied stomach. Today, popcorn comes neatly wrapped in an aluminum foil container, complete with the correct amount of corn, butter and salt. All that is necessary is to shake the dish over an electric or gas burner. An aluminum tent over the dish keeps the popped kernels from flying about. After the popped corn has been consumed the dish is thrown away.

These have been a few of the technological contributions bringing about the kitchen revolution. The boundaries of technology are continually being pushed ahead, and there seems to be no ultimate limit to the march of research, for continual research progress is one of the characteristics of our modern Western civilization.

There are yet many problems presenting a challenge to the food technologist, the solution of which will further ease the tasks of the modern mother and make for better living. As examples of such problems may be mentioned: canned fruits and vegetables that look and taste like the fresh commodity and which can be stored at room temperatures without quality loss; means of prolonging the storage life of fresh fruits and vegetables, meats and poultry; a stable concentrated milk that upon reconstitution will taste like fresh fluid milk; a stable dry whole milk that will reconstitute quickly and taste like fresh milk; dehydrated meats and poultry that are stable at room temperature and will reconstitute to resemble the fresh commodity; a simple method for freezing shell eggs. These are but a few of the countless problems in food technology that beckon the research man.

Research never ends. As Alice was told by the Red Queen in *Through the Looking Glass:* "Now *here*, you see, it takes all the running *you* can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!"

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(Concluded from page 196)

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The report of the *ad hoc* committee to study the Department of City and Regional Planning was discussed in some detail. It was strongly urged that a proposed Center for Urban and Regional Studies be made an integral part of the School of Architecture and Planning and be attached to no other branch of the Institute.

The luncheon period at the Harvard Club, which was extended well into the afternoon, provided an excellent opportunity for general discussion. As a guide to helpful suggestions in regard to the teaching program, approval was expressed for the idea of a survey, to be conducted among those who were graduated from the School since World War II.

Dean Belluschi outlined difficulties in determining satisfactory standards for the selection of promising architectural students. Dr. Stratton pointed out the need for recognizing the difference in temperament and characteristics between desirable architectural students and those planning to study science and engineering.

In conclusion the chairman expressed his thanks to those present for their helpful suggestions, but regretted that only four of the eight members of the Visiting Committee, besides himself, had been able to attend the meeting.

The report was reviewed by the M.I.T. Corporation on June 8, 1956, and by the Executive Committee on August 30, 1956. It was received for publication in The Review on October 25, 1956.

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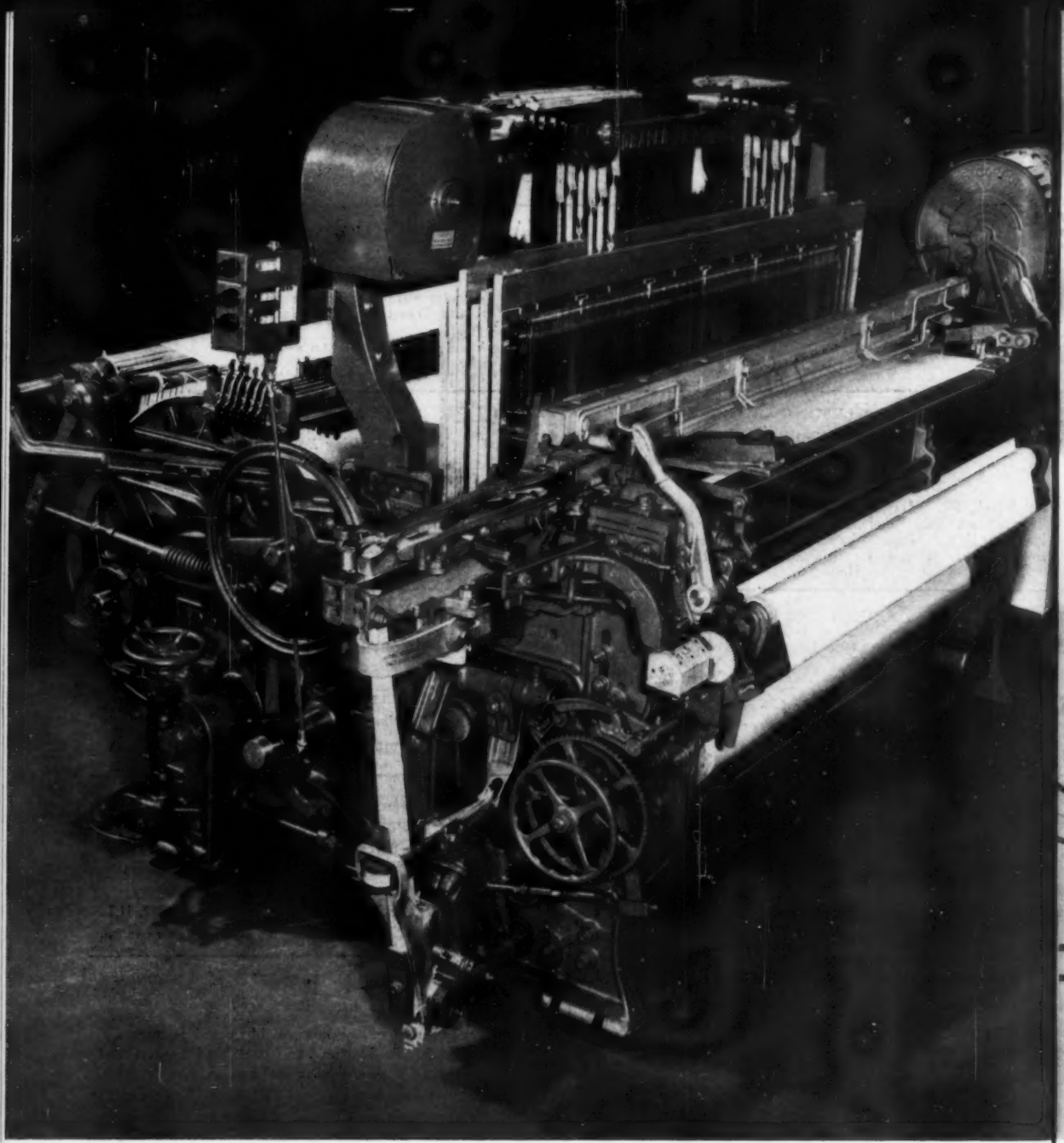

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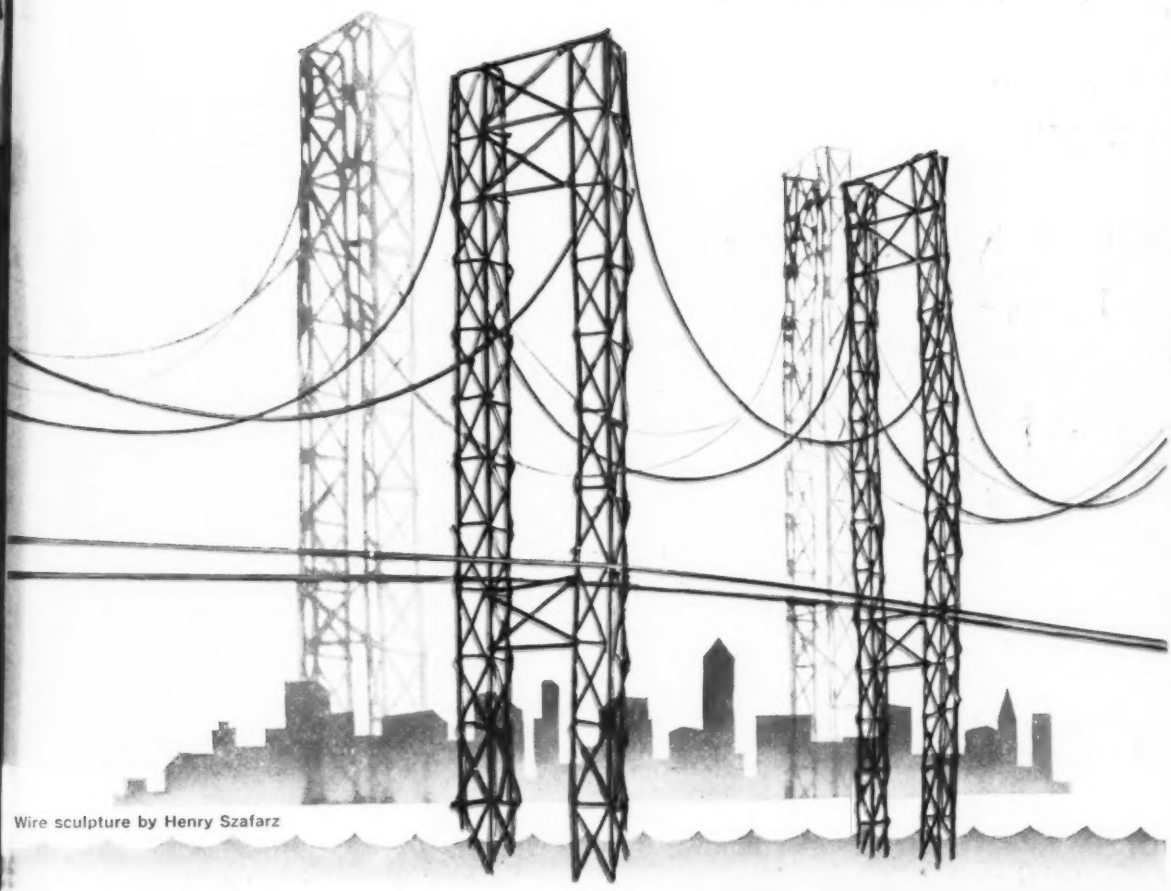

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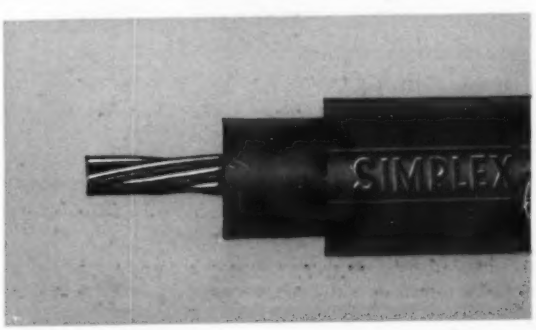

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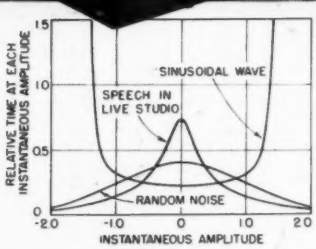

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